PRELIMINARY INDEX OF ESSENTIAL HABITATS FOR CERTAIN MARINE SPECIES OF IMPORTANCE IN THE EASTERN REGION OF NEW BRUNSWICK

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Preliminary index of essential habitats for certain marine species of importance in the eastern region of New Brunswick

by

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Abstract:

Therrien, J., Frenette, I., A. St.-Hilaire, Ferguson, E., Bastien-Daigle, S and C. Godin. 2000. Preliminary index of essential habitats for certain marine species of importance in the eastern region of New Brunswick. Document prepared by the Environmental Sciences Research Centre and the K.-C.-Irving Chair in Sustainable Development of the Université de Moncton, for Fisheries and Oceans Canada. Can. Manuscr. Rep. Fish Aquat. Sci. 2510. vi + 207 p.

This document is a useful planning tool for management and conservation needs, whether from the perspective of the *Oceans Act* or of related objectives such as habitat protection, integrated fisheries management plan preparation or ecosystemic management of resources. With the help of many stakeholders (fishers, fishery officers and biologists), a representative portrait of the information currently available on major marine resources in Eastern New Brunswick was developed. The information is presented in the form of essential habitats for certain marine species, with a total of 30 habitats for 31 species or groups of species having been identified. They are divided in three ecozones: Chaleur Bay, Shediac Valley and the Northumberland Strait. The term essential habitat is used to characterize each species-habitat grouping representative of a vital habitat for a particular wildlife species. These areas are essential for various crucial stages in the life cycle of the species (spawning ground, rearing area, feeding ground, migration area, etc.), or they constitute a major area of concentration, particularly for mostly sedentary species, such as molluscs, for which the boundaries of the area would remain relatively constant from one year to another. Fish concentration areas are generally not included, with the exception of those associated with one particular life stage (larva or juvenile) or a threatened species (cod).

Résumé

Therrien, J., I. Frenette, A. St.-Hilaire, E. Ferguson, S. Bastien-Daigle, et C. Godin. 2000. Répertoire préliminaire des habitats essentiels pour certaines espèces marines d'importance de l'Est du Nouveau-Brunswick. Document réalisé par le Centre de recherche en sciences de l'environnement et la Chaire K.-C.-Irving en développement durable de l'Université de Moncton, pour Pêches et Océans Canada. Rapp. man. can. sci. halieut. aquat. 2514. vi + 208 p.

Le présent document est un outil de planification utile pour des besoins de gestion et de conservation, que ce soit dans l'optique de la *Loi sur les Océans* ou pour des objectifs connexes comme, par exemple, ceux de la protection de l'habitat, de la préparation de plans intégrés de gestion des pêches ou de la gestion écosystémique des ressources. Avec le concours de multiples intervenants (pêcheurs, agents des pêches et biologistes), un portrait représentatif de l'information actuellement disponible sur les ressources marines majeures de l'est du Nouveau-Brunswick est fourni. L'information recueillie est présentée sous forme d'habitats essentiels pour certaines espèces marines. Un total de 30 habitats essentiels pour 31 espèces ou groupes d'espèces ont ainsi été identifiés, répartis dans trois écozones, soit : la baie des Chaleurs, la vallée de Shédiac et le détroit de Northumberland. Le terme habitat essentiel est utilisé pour caractériser chaque ensemble habitat-espèce représentatif d'un habitat vital pour une espèce faunique particulière. Ils sont essentiels pour une des étapes cruciales du cycle de vie de l'espèce (frayère, aire d'alevinage, zone nourricière, zone de migration, etc.), ou bien il s'agit d'un lieu de concentration majeure, particulièrement pour les espèces peu mobiles, comme les mollusques, pour lesquels la délimitation de la zone serait relativement constante d'une année à l'autre. Ainsi, les zones de concentration de poisson ne sont généralement pas retenues, à l'exception de celles associées à un stade de vie particulier (larve ou juvénile) ou à une espèce en difficulté (morue).

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1. INTRODUCTION

At the dawn of a new millennium, the management of the oceans provides a number of opportunities and challenges for Canadians. The diversity, richness and abundance of marine ecosystems will continue to offer important socio-economic and cultural dividends for present and future generations, if properly managed. Oceans still provide great opportunities not only for scientific research, but also for fisheries, aquaculture, tourism, transportation and commerce, energy production and mining, as well as emerging technologies. The Canadian identity is rooted in part in our cultural, educational and social heritage, which is, in many cases, associated with the marine ecosystem.

Over the last few years, the entire traditional management approach to marine resources has been re-examined. As early as 1982, the adoption of the United Nations' Convention on the Law of the Sea signalled a shift towards a more global perspective with regards to the oceans. The concept of sustainable management of inorganic and organic marine resources was also adopted at that time. Ten years latter, Agenda 21, approved at the Rio Conference, affirmed that the protection and sustainable development of the oceans required a new management approach. Agenda 21 dealt with integrated management, protection of the marine environment, and the sustainable development and use of marine resources. Concepts such as the precautionary approach, ecosystem-based management and integrated management have since been adopted, within a legal framework. These concepts are now key components of the ocean management objectives of many countries, including Canada.

The *Oceans Act*, given assent in 1996 by the Canadian government and implemented in January 1997, targets the same ocean conservation objectives contained in international accords ratified by Canada. It entrenches the principles of sustainable development, ecosystem-based management, community-based approaches, integrated management, and a precautionary approach as the new framework for a balanced management of ocean resources.. The *Oceans Act* works with other existing tools, such as the *Fisheries Act,* which protects commercial species and contains several habitat protection provisions.

In order to meet all these objectives in a practical manner, especially those relating to ecosystem-based and integrated management, a thorough knowledge of the environment is required. This document has been prepared in order to highlight key information required to assess the major ecological areas along the eastern coast of New Brunswick. The objective of this report is to set out the data needed for ocean and coastal zone integrated management within a broader ecosystem

management plan. It is part of a pilot project in ecosystem planning designed to meet the objectives of the *Oceans Act*.

A holistic approach to oceans management, as indicated by an ecosystem-based approach, requires the integration of economic, social and environmental objectives. It is aimed at meeting ecosystem conservation criteria while meeting the many needs of stakeholders. An integrated management approach is one of the tools proposed in the new *Oceans Act*, along with the possibility of creating marine protected areas (MPAs), and the establishment and the application of Marine Environmental Quality (MEQ) criteria and standards. These tools are being implemented progressively in various coastal regions of our country. Efficient implementation of this new approach requires the prior identification of essential habitats or ecosystems for marine species.

The present study provides an overall picture of eastern New Brunswick, from the Quebec border to the Nova Scotia border, in the Northumberland Strait. The approach used in this study was a review of the empirical ecological knowledge of the people, and is mainly founded on consultations with stakeholders and scientists and an inventory done using data provided by over 1000 fishers and verified by biologists, compiled in an atlas entitled «*Traditional Fisheries Knowledge for the Southern Gulf of St. Lawrence*» (J. Lee MacNeill & Associates, 1998).

As such, it is not a purely scientific tool giving an exhaustive list of marine resources, but rather a planning tool for management and conservation needs. With the assistance of multiple contributors (fishers, fishery officers and biologists), it provides a representative picture of the information currently available on major marine resources. It can be used not only for the purposes of the *Oceans Act*, but also for related objectives, such as habitat protection, or integrated fisheries management planning or ecosystem-based resource management.

DFO commissioned the Environmental Sciences Research Centre and the K.C. Irving Chair in Sustainable Development, both at the Université de Moncton, to prepare this report. The process leading to the creation of this document is described in the following sections, preceded by a general overview of the southern Gulf area.

1.1 General overview of the southern Gulf

This overview is divided into two sections: the ecological and the economic characteristics of the area.

1.1.1 Ecological characteristics

The region is divided into three ecozones according to their main ecological characteristics (Figure 1): Chaleur Bay, the Northumberland Strait and Shediac Valley:

- Chaleur Bay consists of a semi-enclosed area opening on the Gulf, which is influenced by the freshwater discharge from a number of major rivers, the most important being the Restigouche River. A cyclonic current gyre located near the mouth of the bay enhances productivity in the area (DFO, 1998f):

    - ◊ It shelters considerable fauna (large kelp beds, 157 taxa of benthic marine algae, over 250 species of molluscs, amphipods and echinoderms, and other benthic organisms associated with nearshore muddy bottoms);

    - ◊ It contains a particularly high zooplanktonic diversity and richness (invertebrate larvae, and fish eggs and larvae);

    - ◊ It is a migration route for numerous species (marine mammals, aquatic birds, fish such as the Atlantic mackerel, the Atlantic salmon and the Bluefin tuna, and crustaceans such as the snow crab, etc.), which take advantage of this productivity.

- The Northumberland Strait, 200 km long and 20 km wide, is relatively shallow (less than 40 fathoms or 64 m). It separates New Brunswick and Nova Scotia from Prince Edward Island and allows current exchanges between the Shediac Valley and the Cape Breton peninsula. It is also a productive environment, due to warmer waters and the presence of current gyres at both ends of the region covered by this study, i.e. around Point Escuminac and Baie Verte. Deep-water species are generally absent (cetaceans, snow crabs, some groundfish), but it nevertheless shelters a rich invertebrate fauna, and is used as a migration route by a number of fish species, notably striped bass and Atlantic salmon.

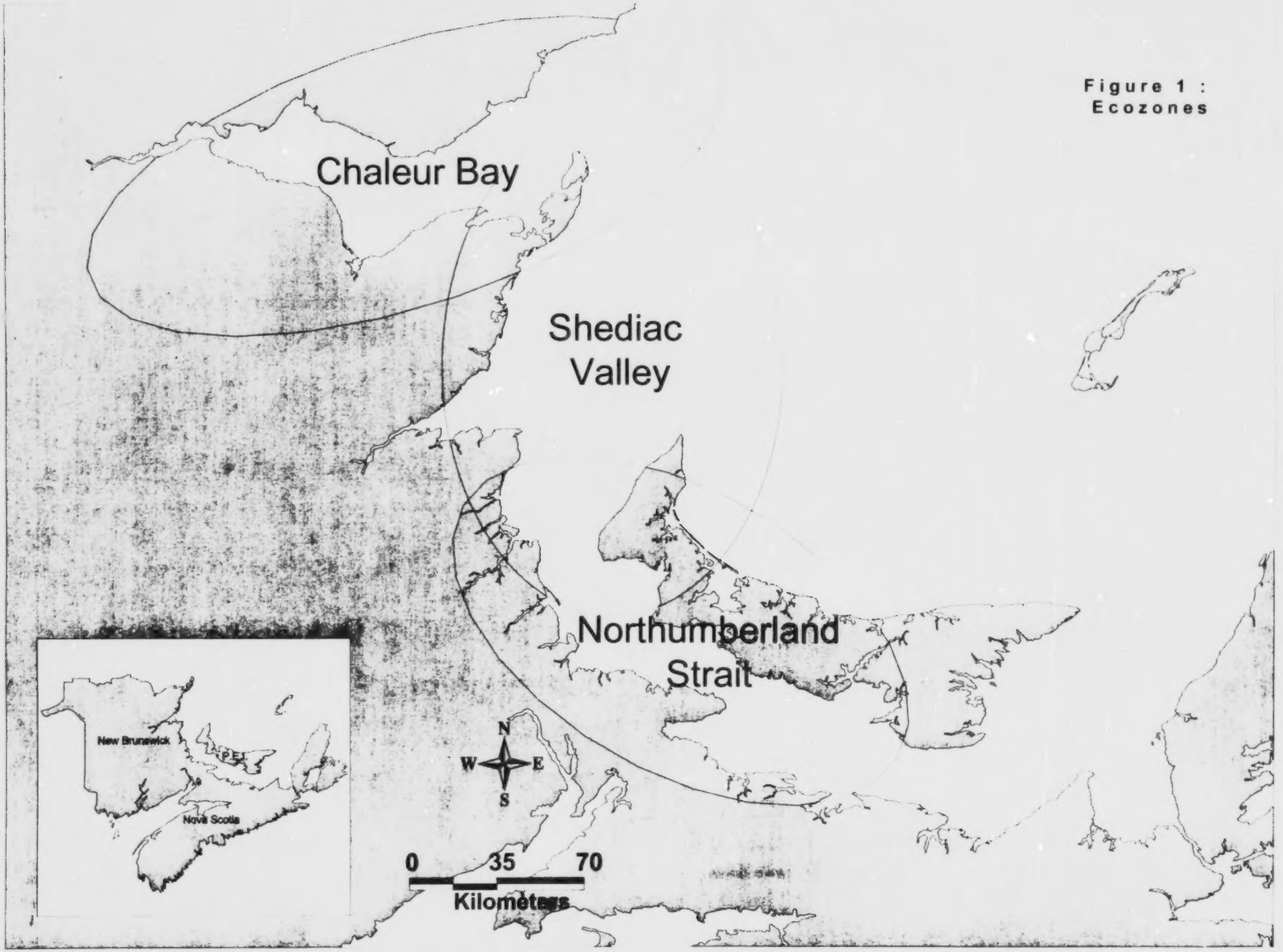


Figure 1 :
Ecozones

- Shediac Valley consists of an open area having approximately the same characteristics as the Gulf. Gyres are present at either end of the valley, near the boundaries with adjacent ecozones. The Miscou gyre provides the same productivity benefits as the one in Chaleur Bay. Dominant southwest winds also produce anticyclonic gyres in Shediac Valley, which enhances fish larvae retention and promotes productivity (Koutitonski and Bugden, 1991). Shediac Valley harbours all the Gulf species and also offers diversified and productive coastal habitats, notably the Miscou Bank and Miramichi Bay. As many as 78 species of fish have been observed in the Miramichi River and estuary (McKenzie, 1959).

Finally, the ecozones and associated ecosystems are all linked. In biophysical terms, all three ecozones are part of the Magdalen Shallows within the Gulf of St. Lawrence, and are characterised by many common features (de Lafontaine et al. 1991). The shoal has the greatest zooplankton and ichtyoplankton diversity of the Gulf, with the highest concentrations of zooplankton and fish larvae in its western portion.

1.1.2 Economic characteristics

New Brunswick's economy has always been dependent on its natural resources, be they forests, mines or fish. These primary resources have been and continue to be an important source of income for a large number of New Brunswickers.

Even though the fishing industry is not as profitable as in the 1970s (particularly since the closure of the groundfish fishery in 1993), it nevertheless continues to be a major industry for a number of New Brunswick coastal villages. In 1999, for example, the total value of fish and seafood exports in eastern New Brunswick was over $120 million. In comparison, exports in the forestry industry, the second largest employer in the province, reached $1.5 billion in 1994 in for the entire province of New Brunswick.

Between Campbellton to the north and Baie Verte to the south, several towns and villages depend directly on fishery resources for their survival. Over 5,600 fishers in 14 statistical fishing districts on the province's east coast hold some 10,000 fishing permits. The districts covering the area from Caraquet to Tracadie, including Shippagan, the Miscou and Lamèque islands, and the district of Point Escuminac are among those with the largest number of fishers. The most common commercial fishing licences, by number are: American oyster, Atlantic herring, Atlantic mackerel, American lobster, groundfish and soft-shell clam.

In terms of the value of landings, lobster ranks first with over $60 million for 1999, followed by snow crab with $22 million, northern shrimp with $7 million, Atlantic herring with $4.8 million and sea scallop with $2.1 million.

2. METHODOLOGY

2.1 Selected themes

The project team at DFO selected four themes for its description of essential habitats, which are:

- Ecological features
- Vulnerability, threats and human pressure
- Socio-economic characteristics
- Support, favourable and unfavourable factors

Under "Ecological features", each habitat is described in terms of its role and its ecological value, and its specific (particular species or communities, rare or endangered species status) and ecosystem characteristics. These include the type of habitat or ecosystem (spawning ground, nursery area, feeding area, nesting area, lagoon, marsh, estuary, etc.) and major biotic (productivity, breeding, etc.) and abiotic (currents, erosion, etc.) processes.

"Vulnerability, threats and human pressure" deal with the potential problems related to the conservation of the habitat. It puts in perspective its vulnerability (fragility, sensitivity, scarcity, isolation, etc.) and its components of interest. In addition, a description and, if possible, an evaluation of anthropogenic (human) factors (pollution, exploitation, navigation, etc.) which threaten, disturb, have disturbed or could disturb habitat integrity are also included.

The theme "Socio-economic characteristics" describes the human presence in the area, including uses of the resources and occupation of adjacent territories. The economic (different operations including commercial fishery, tourism, navigation, etc.) and leisure activities (pleasure boating, scuba diving, etc.), and government jurisdictions, native claims, etc. are also described.

Finally, the theme "Support, favourable and unfavourable factors" reviews the context (proximity of other protected areas, economic constraints, logistic problems, etc.), and lists the individuals and organisations who would be in favour of or against changes in status (i.e. the creation of MPA's) or changes in resource

management (e.g. integrated, coastal or ecosystem management) of the habitat involved.

2.2 Data collection

Data for this report were gathered in three stages: by consulting DFO researchers, by a literature review and by interviewing fishery officers. In addition, researchers and managers working in the marine environment commented on a first draft of this report during a workshop held in June 1999, where the working paper was presented.

2.2.1 Meetings with DFO researchers

DFO researchers were initially consulted to propose essential habitats on the basis of specific species. They were later interviewed a second time regarding specific information on each identified essential site. Discussions were based on ecological features, vulnerability and pressures and on support and favourable or unfavourable factors.

2.2.2 Literature review

A literature review was also undertaken to document some of the statements made by researchers. Documents included: DFO stock status reports, which describe the vulnerability of a given species and particular habitats of the concerned resources; and DFO landing statistics, which provided the information used to describe the socio-economic importance of each habitat of interest. The atlas entitled "Traditional Fisheries Knowledge for the Southern Gulf of St. Lawrence" (J. Lee MacNeill & Associates, 1998) presents an overview of fishers' traditional knowledge of the distribution of the marine resources in the area. The references quoted most often in this report include: Chadwick [ed.] (1995), *Water, Science and the Public: The Miramichi ecosystem,* Klassen and Tremblay (1998) [ed.], *Proceedings of a workshop on estuaries in the Southern Gulf of St. Lawrence. Kouchibougouac National Park, November 13-15, 1996,* Eaton et al. (1994), *The State of the Environment in the Atlantic*, Hildebrand (1984), *An assessment of environmental quality in the Chaleur Bay*, and Hunter (1975), *Beach resources of Eastern New Brunswick*. The complete list of references is included at the end of the report.

2.2.3 Meeting with fishery officers

The final step in collecting the data for this report was a series of interviews with DFO fishery officers from the Dalhousie, Bathurst, Caraquet, Shippagan, Tracadie-Sheila, Neguac, Baie-St-Anne, Miramichi and Richibucto districts (which included the area from Shediac to Baie Verte). Information gathered included precise

essential habitat locations, active commercial fishers (the type of fishery, gear types, licences and fishing seasons) using these habitats, potential public pressures and threats and the lobbying to be expected further to changes in the status or management of these habitats.

2.3 Essential Habitats

The information in this report is presented in the form of essential habitats for certain marine species. An essential habitat means a "species habitat" i.e. a vital habitat for a given species. The sites identified are essential habitats for important life stages (e.g. spawning, nursery, migration, overwintering, etc.), or high-density habitats for less mobile species such as molluscs, for which area boundaries remain relatively constant from one year to the next. High fish concentration areas were usually not included, except for areas associated with specific life stages (larval or juvenile), or areas of high concentration of a stock which is rebuilding, such as Atlantic cod. Habitats like Miscou harbour, the MacGregor and Windsor lagoons on Miscou Island, Heron Island kelp beds, eel grass beds and salt marshes proposed by DFO biologists were the only exceptions to this definition and were identified because of their great potential as coastal habitats and specific ecosystem features.

The majority of the other habitats identified were mainly related to species having a commercial or recreational interest, for which there are usually more data available. Marine mammals and shorebirds were also mentioned in certain areas. The list is not comprehensive and is a function of the level of information available. In some cases, even for some commercially harvested species, there was no information available on essential habitats, such as spawning grounds. For others, such as eel, cod and American plaice, known spawning habitats are located outside of the study area. Non commercial species have been less studied even if, in some cases, they are known to be important elements in the food chain and key links between trophic levels.

Some of the marine resources are not included because of their widespread distribution. They are omnipresent and it is difficult to identify a habitat of particular importance. Some kelp beds, small aquatic bird colonies, small concentrations of pinnipeds or molluscs (especially the soft-shell clam and the blue mussel) are good examples of such resources. Quality habitats such as lagoons are also not presented, given their number along the New Brunswick coast (e.g. those in Tabusintac and Tracadie). In spite of their large numbers, these habitats should be identified for protection because of their ecological importance for a number of marine species.

Essential habitats are presented in two steps. The information on the first group of habitats of interest is presented in a "Fact Sheet" format as described in section 2.1 (selected themes). These habitats were identified during the preliminary consultation undertaken by Mr. Ernest Ferguson (DFO), and interviews with stakeholders (researchers, managers, etc.) and for which a lot of information has been gathered over the years. A second group of habitats, less well documented, were identified during the consultations undertaken by the authors of this report. They are identified on maps, followed by a brief description, in the appendices. It is hoped that the fact sheet format used in this document will facilitate its updating when additional information is obtained.

Statistical information on landings and their market value was estimated for each area encompassing each essential habitat. Native fisheries were not included because there is little data available at this time.

3. ESSENTIAL HABITATS

This chapter contains information, in fact sheet form, on the species habitat association of 34 essential habitats, which were identified in the preliminary steps of data collection, described according to the four themes developed in section 2.1. In addition a list of associated essential habitats (described in fact sheets or appendix) is provided for the same habitat, as it pertains to another species. A list of other essential habitats for the same species is also provided.

Four major species habitat categories are included, i.e. habitats associated with the following groups: fish, crustaceans, molluscs and specific habitats.

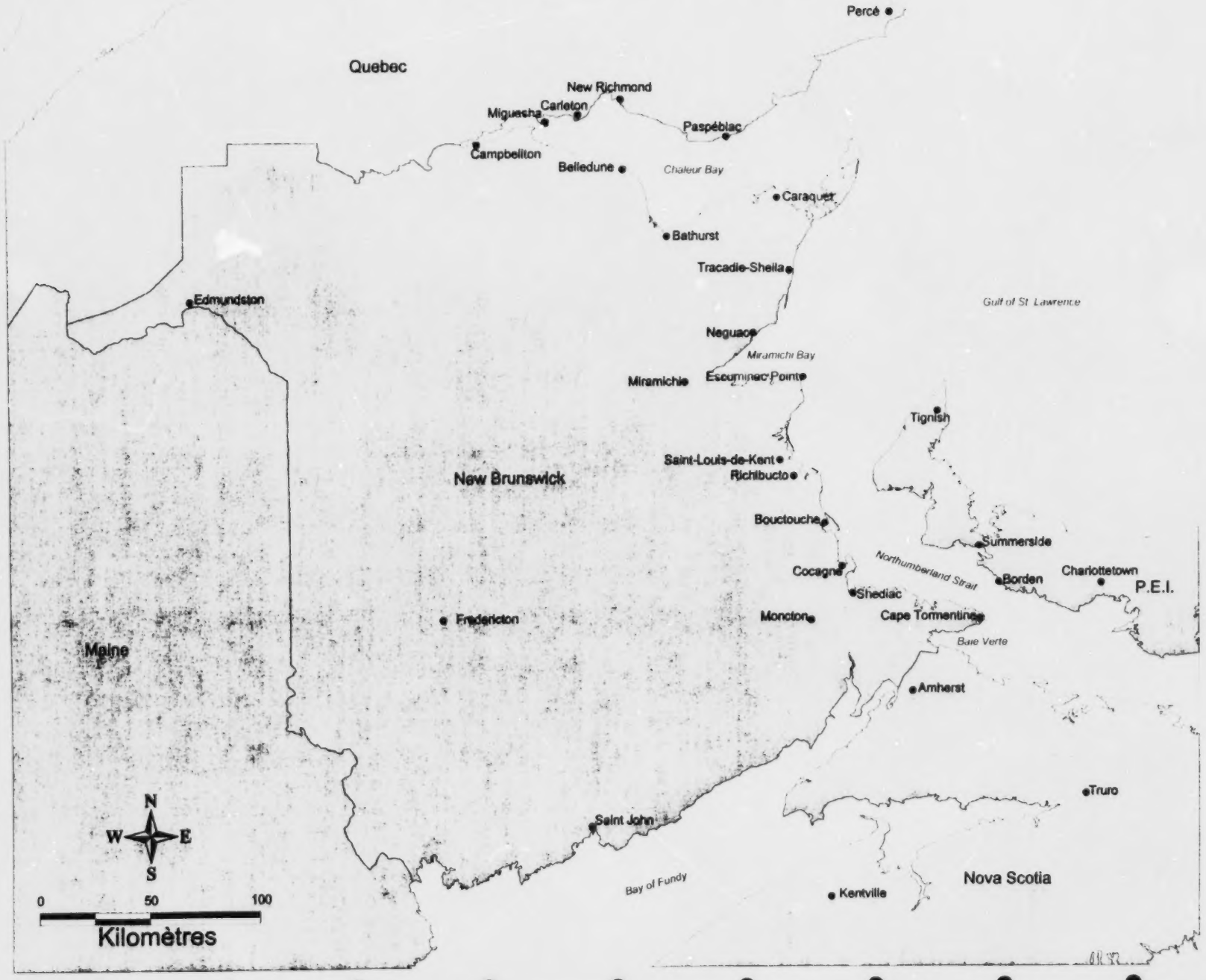
Other essential habitats

As described in section 2.3, other habitats were identified during a second phase of data collection. They are grouped by species in appendix A, where each habitat is briefly described and situated on a map. Appendix B lists the scientific names of the species mentioned throughout the report.

Please note:

The information on fishing seasons and the number of fishers in the socio-economic sections comes from fishery officers' estimates. The number of active fishers in each region is an approximation. These numbers provide information on the number of individuals by fishing activity and not the fishing effort (i.e. gear density). A same fisher may be engaged in a number of fisheries. This information should only be used to assess the relative importance of the area for the fishers. For example, the number of recreational fishers harvesting mackerel, groundfish, and clam is expressed in fisher-days. The same people may be fishing during several days. The number for smelt recreational fishing represents the number of ice shacks and should probably be multiplied by 4 (4 fishers/shack).

Figure 2 : Map of Eastern New Brunswick



3.1.1 Miscou harbour and Fox Dens beach

Ecological Features

- Miscou harbour and Fox Dens beach are aquatic habitats known for their high productivity[f1] (Figure 3.1.1.). The area extends from the eastern shore of the island to the 6-fathom (8 m) isobath, and includes Wilson Bank.
- Miscou harbour, like Shippagan Bay, is a high productivity area because of the rapid tidal flushing resulting from different water levels in Chaleur Bay and the Gulf of St. Lawrence.[f1]

Vulnerability, threats and human pressure

- The stability of the barrier islands at the southwest entrance to Miscou harbour must be maintained, as the narrowness of the gully thus created affects tidal exchange velocity.
- There are a large number of cottages along the shoreline on Lamèque Island and in Shippagan[f2].
- There are several municipal beaches on Miscou and Lamèque islands[f3].
- Tourism activities such as whale watching and boat tours are carried out on both islands.[f3]
- There are many fishing wharves on the two islands and in Shippagan.
- Effluents from fish plants on Lamèque Island may affect the 2 sites (wharf and beach) because of the littoral currents[f2]. The effluents are characterised by high bacterial concentrations[f7].
- Dredging to expand the Miscou and Fox Dens channel may increase turbidity in the vicinity.[f2]
- There are turbidity and sedimentation problems caused by two peat processing operations on Lamèque Island; their effluents spill into the bay.
- There are several oyster-farming leases in Miscou harbour[f6].

Socio-economic characteristics

- Species harvested in this sector include smelt, fished between October and February (approx. 30 fishers), lobster in May and June (100), oyster between October and December (10) and clams between August and December (5 commercial harvesters and over 200 recreational harvesters). One mussel grower is also located in this habitat[f6].

Support, favourable and unfavourable factors

Other associated essential habitats

- Miscou Harbour and Fox Dens Beach are essential habitats for juvenile and adult fish of several species, probably including bass, capelin, smelt, herring, mackerel, flounder, as well as various molluscs and crustaceans. High waterfowl and shorebird concentrations were also identified in this habitat[f5].

References

F1 : D. Haché, p.c. 1999

F2 : Hunter,1975

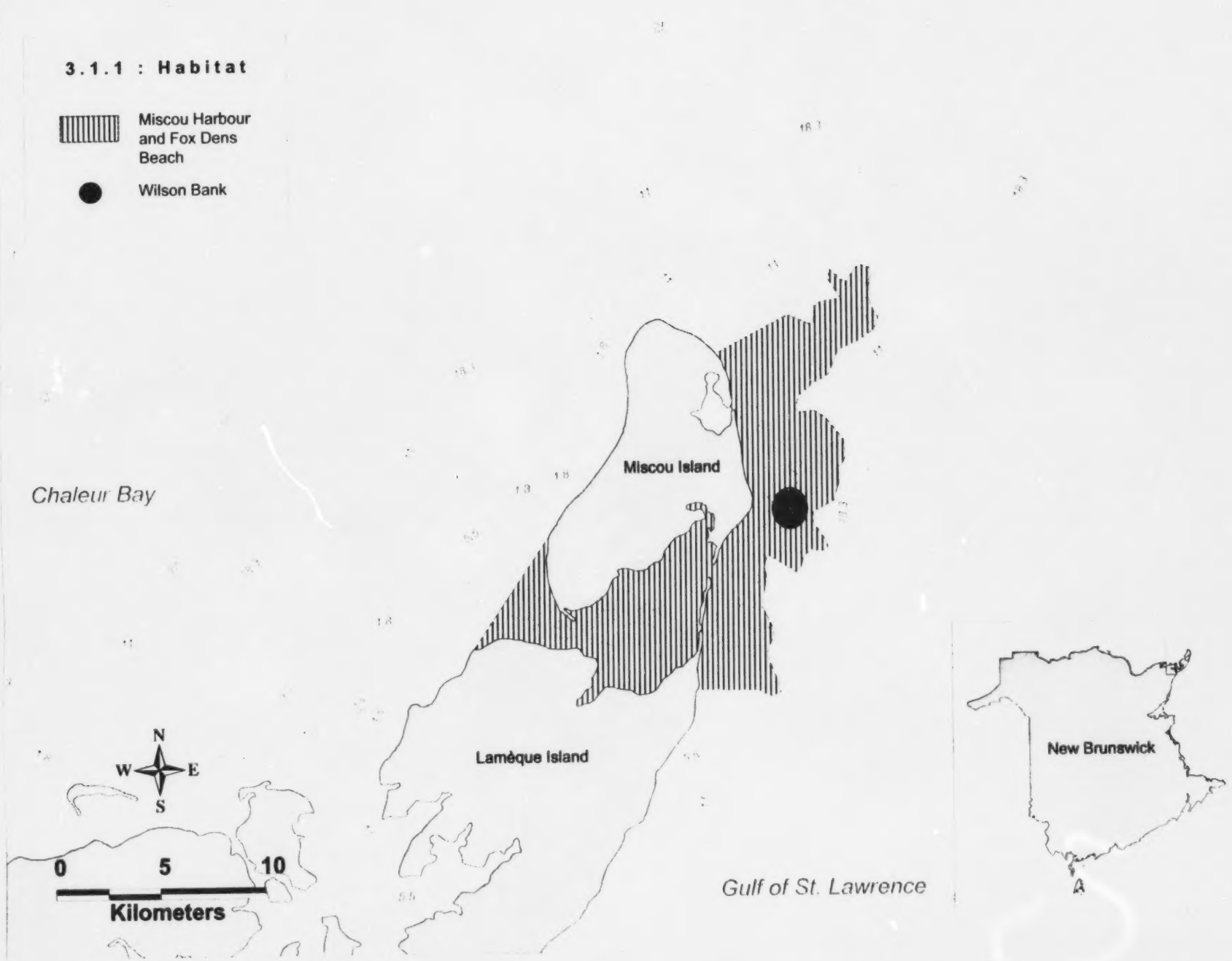
F3 : Department of Economic Development and Tourism, 1998.

F4 : DFO Statistics, 1998

F5 : CWS via E. Ferguson, p.c., 1999

F6 : Fishery officers, Shippagan District, p.c. 1999

F7 : E. Ferguson, p.c. 1999


3.1.1 : Habitat
Miscou Harbour and Fox Dens Beach
Wilson Bank
Chaleur Bay
Miscou Island
Lamèque Island
Gulf of St. Lawrence
N
W
E
S
0
5
10
Kilometers
New Brunswick

3.1.2 MacGregor and Windsor MalBays (Miscou Island)

Ecological Features

- MacGregor and Windsor MalBay on Miscou Island are known for their high productivity of a number of aquatic resources[w1] (Figure 3.1.2). This is attributed to the brackish waters and relatively high temperatures, which are also characteristic of other highly productive ecosystems such as estuaries, salt marshes, sheltered bays and barachois[w2, 3].
- Similar habitats are found along the New Brunswick coastline between Miscou and Baie Verte, especially near Tracadie and Tabusintac[w4].
- One of the unique features of malbays is the fact that there is no freshwater input, which means that the shallow waters tend to heat up much more quickly in the spring than in other bays[w1].

Vulnerability, threats and human pressure

- The stability of barrier islands at the mouth of these lagoons must be maintained as they limit exchanges with the Gulf, depending on the tides, creating special habitat conditions.
- There are a large number of cottages along the shoreline on Lamèque Island and Shippagan[w5].
- There are several municipal beaches on Miscou and Lamèque islands[w6].
- Ecotourism activities such as whale watching and boat tours are carried out on both islands[w6].
- There are several fishing wharves on the islands and at Shippagan.
- Dredging to expand the Miscou and Fox Dens channels will increase turbidity in adjacent waters[w5].
- Currently, commercial peat moss harvesting on Miscou Island has ceased due to a moratorium[w4].
- Angling, hunting and traditional tourism are carried out in the malbays[w1].

Socio-economic characteristics

- The only commercially harvested species in these habitats is the American eel (between January and December), which is harvested using either hoop nets (2 fishers) or harpoon (30 fishers)[w8].
- There are no commercial fisheries inside the malbays.

Support, favourable and unfavourable factors

- In 1974, a DNRE study concluded that these two malbays should be designated "ecological reserves"[w5].

- They are the sites of major seabird colonies (see Figure A 3.5.3).

Other associated essential habitats

- The Miscou lagoons constitute a habitat of interest for juvenile and adult fish (e.g. adult bass) of several species, molluscs, crustaceans and waterfowl.

References

W1 : D. Haché, p.c., 1999

W2 : Kerekes, 1998

W3 : Butler, 1993.

W4 :.E. Ferguson, p.c., 1999

W5 : Hunter, 1975

W6 : Department of Economic Development and Tourism, 1998

W7: DFO Statistics, 1998

W8 : Fishery officer, Shippagan District, p.c. 1999

3.1.2 : Habitat

MacGregor and
Windsor MalBays

3.1.3 Heron Island kelp beds

Ecological features

- The kelp bed located north-east of Heron Island is probably the largest along the northeastern New Brunswick coast. It was identified during a recent study on sea urchins in the area[a1]. Kelp beds, like most other macrophytes except calcareous matter, are often associated with high sea urchin density because the latter feed on them[a2]. Therefore, the kelp bed area and density will fluctuate in accordance with the grazing pressure. Other kelp beds identified by this study are located north of Caraquet Island, east of Miscou Island and around Point Escuminac.
- Heron Island is a rich environment that, in addition to kelp, is also characterised by high concentrations of sea urchins[a1], and shellfish[a3,a4]. The Island is also home to a number of species of seabirds (murres, herons, eiders, scoters and Harlequin ducks)[a5] (Figure A 3.5.2).
- The western portion of Chaleur Bay is highly productive and provides a seasonal habitat for a number of marine mammals, waterfowl, fish (mackerel, tuna, salmon, etc.) and crustaceans (snow crab). It is also home to a wide diversity of benthic algae and many benthic organisms associated with muddy circalittoral habitats (mostly molluscs, amphipods, and echinoderms)[a6]. However, kelp beds are more abundant in the Quebec portion of the bay, and the resource is rarer on the New Brunswick coast.

Vulnerability, pressure and threats

- Kelp being aquatic plants (macrophytes) attached to the bottom, dragging can damage this resource.
- Sea urchins feeding on kelp may also affect concentrations.
- A number of industries are located on the northern and southern shores of the bay, and throughout the Chaleur Bay drainage basin. They include pulp and paper mills, mines, a smelter, a fertilizer plant, thermal power plants as well as a number of fish processing plants[a7,a8,a9].
- Chaleur Bay as a whole is considered to be healthy, although there are local pollution problems, especially between Bathurst and Dalhousie [a7].
- The mining industry is a significant source of pollution. The Brunswick and Caribou mines, which process zinc, copper and lead, are located near the Little River, which empties into the Bathurst and Forty Miles Creek harbours. In the early eighties, there were problems with acidic water and heavy metal contamination[a8]. Conditions have improved since 1982, following the construction of a separate water treatment plant for the mine. However, in spite of these efforts, there are still some problems with low pH, associated with a by-product of partially oxidised sulphur compounds called sulfosalts. The bacteria

that oxidise these salts are the only living organisms in the Little River at this time. The problem is particularly difficult to resolve because the biological oxidation process is still active after the wastewater has spilled into the Little River[a10].

- The Belledune smelter produces effluents with some toxic heavy metal content such as cadmium. The lobster fishery in the Belledune harbour had to be closed on a few occasions because of this problem[a8,a10]. In 1981, effluent cadmium concentrations had decreased by as much as 97%. In 1986, however, an increase in Cd concentrations was noticed in lobster, and concentrations remained high in 1987 and 1988. This contamination was caused by improper land filling techniques for contaminated wastes and a problem with one of the effluent pipes in the recycling system. The broken pipe was replaced in 1989, but it is still unknown if the measures taken were effective[a10]. The inner harbour is still closed to lobster fishing[a5].
- The fertilizer plant in Belledune discharges raw toxic effluent with low pH and high concentrations of fluoride and suspended sediment, with traces of nitrotoluene and other compounds, including heavy metals[a10]. This plant is presently closed[a5].
- PCI Chemicals in Dalhousie produces chlorine and caustic soda used by pulp and paper mills. This plant uses a mercury cathode process that, between 1976 and 1987, was responsible for discharging 5.3 tons of mercury into the environment[a10].
- Pulp and paper mills discharge liquid and gas effluents, as well as contaminated solid wastes[a8]. It should be noted, however, that the Atholville and Dalhousie plants have improved their treatment facilities in the last 5 years.
- Pulp and paper mills produce more effluents (consisting of dissolved organic and inorganic compounds, suspended matter) than any other industry in the area[a10].
- The Dalhousie thermal power plant uses 20 000 tonnes of orimulsion per year. This oil-based emulsion in water has high polycyclic aromatic hydrocarbon (PAH) concentrations and may threaten benthic organisms, including scallop beds in the bay, if a spill occurs[a11]. A spill would affect marine algae, including kelp beds.
- Fish plants located in the eastern portion of the bay produce effluents with high Biological Oxygen Demand (BOD). The effluents also have high bacterial counts and the plants also produce large quantities of solid wastes, which must be either dumped in the bay or on land[a10].
- There are two marinas located in the bay, one in Bathurst (100 boats) and one in Dalhousie (30 boats)[a12].
- Two major ports are also located in the area: Dalhousie (second largest port in New Brunswick) and Belledune (third largest port in the province). There are also a number of smaller fishing wharves.

- Tourism is also important in Dalhousie (sea kayaking, boat tours and ferry crossing to Miguasha), in Caraquet (boat tours, kayaking and whale watching), and in Bathurst (excursions on the Nepisiguit River, boat tours)[a13].
- A ferry travels between New Mills and Heron Island.

Socio-economic characteristics

- Species harvested in this habitat include lobster in May and June (13 fishers), sea urchin in April and between September and November (1 fisher) and rock crab in May and June and between August and October (6 fishers)[a17].
- Two First Nation communities are located on the southern shore of Chaleur Bay: Eel River Bar and Pabineau Falls, and two others are located on the north shore (New Richmond and Maria).

Support, favourable and unfavourable factors

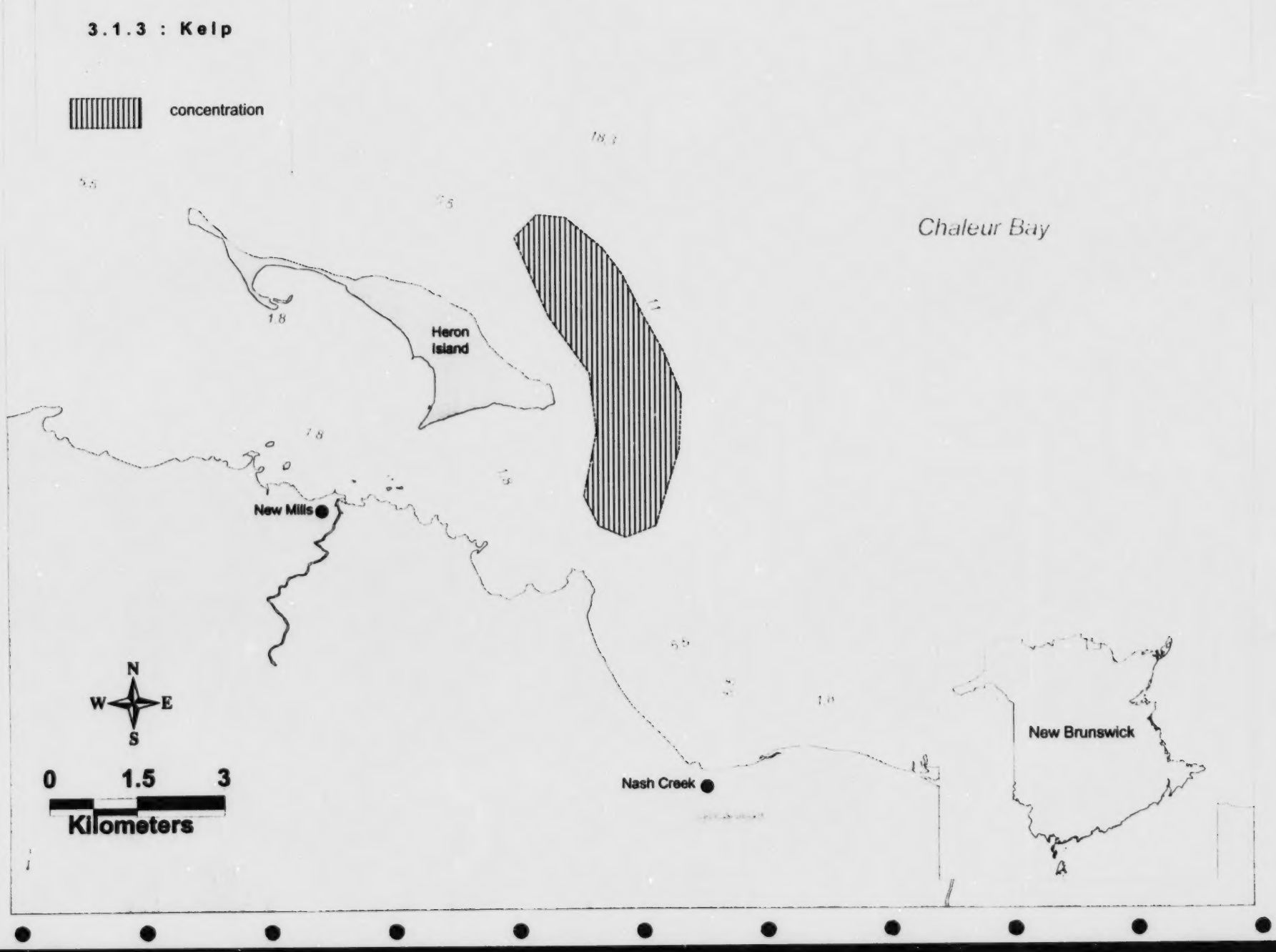
- Heron Island is a provincial park reserve.
- Protection of this habitat is supported by the Canadian Wildlife Service because of the site's high concentration of seabirds (Figure A 3.5.2).
- This habitat is part of a larger area that has been nominated as an "Important Bird Area (IBA)" because it is considered important for a number of coastal bird species.[a5]

Other associated essential habitats

- Heron Island is an area of interest for the following species: herring (nursery area in the western part of the bay, 3.2.3), and Atlantic mackerel and sea urchin (see appendix).

References

A1 : Lanteigne and Lanteigne 1993
A2 : Miller, 1985
A3 : T. Landry, p. c. 1999
A4 : SENPAQ, 1996
A5 : E. Ferguson, p.c. 1999
A6 : MPO (Laurentian MPA), 1998
A7 : Hildebrand, 1984
A8 : Breau, 1998
A9 : Gagnon et al. 1997
A10 : Eaton and Gray, 1994
A11 : Federal-Provincial-Territorial Advisory Committee, 1999
A12 : Washburn and Gillis, 1989
A13 : Department of Tourism and Economic Development, 1998
A14 : Perley, 1852
A15 : DFO (herring) 1999
A16 : DFO Statistics, 1998
A17: Fishery officers, Dalhousie, p.c. 1999


3.1.3 : Kelp
concentration
Chaleur Bay
Heron Island
New Mills
Nash Creek
New Brunswick
N
W
E
S
0
1.5
3
Kilometers

3.1.4 Wide distribution habitats: eelgrass beds

Ecological Features

- Eelgrass beds are known for their high primary production and are a key element in the coastal food chain[z1].
- Eelgrass provides food and shelter during the juvenile stages of many large fish (e.g. herring, winter flounder, sculpin, and mackerel), as well as smaller fish (stickleback, killifish, mummichog and silverside)[z1].
- Eelgrass is also a substrate for egg deposition for a number of species, such as herring[z1].
- It is also an important source of food for many birds such as brant geese and many species of ducks[z1].
- Eelgrass is found in high concentrations in sheltered areas such as barachois, lagoons, and sheltered bays with gentle slopes and fine substrate[z1].

Vulnerability, threats and human pressure

- Some areas are threatened by human activity such as land filling, drying out or trampling).
- There are very few eelgrass beds in Chaleur Bay, but they are commonly found in estuaries between Caraquet and Baie Verte, especially in Shippagan, Tracadie, Tabusintac, Miramichi, Kouchibouguac, Richibucto, Bouctouche, Shediac, Cap-Pele, and Baie Verte.
- Disease or climatic changes wiped out large concentrations of eelgrass in the early 1930s[z2].

Other associated essential habitats

- Eelgrass has also been associated with the following habitats of interest: White hake spawning grounds in Baie Verte (3.2.15).

References

Z1 : DFO (MPA Laurentian Region) 1998

Z2: Rasmussen, 1977

3.1.5 Wide distribution habitat: salt marshes

Ecological Features

- High primary macrophyte production (Spartina, eelgrass, scirpus, salt marsh, mucilaginous algae) leading to a high secondary production[R1].
- Spawning, nursery, feeding and resting habitat for a number of freshwater, anadromous, catadromous and pelagic fish[R1].
- Essential for the production of many fish species, including sticklebacks, and also used by juvenile tomcod and rainbow smelt [R1].
- Flounders, both winter and smooth, in particular are found at high densities in the mud flats associated with these marshes [R1].
- Salt marshes export a large quantity of nutrients into adjacent coastal habitats, which is important for higher levels of the food chain.
- Important for waterfowl breeding.
- Salt marshes have an important water filtering capacity

Vulnerability, threats and human pressure

- Many marshes are threatened by human activity such as trampling, drying out, and landfilling, especially in southeastern New Brunswick, near Shediac, Cap-Pele and in northern New Brunswick in Lamèque.
- Salt marshes are found in all the areas mentioned herein. In addition to coastal marshes typically found in estuaries, barachois, and lagoons, large salt marshes are found behind barrier islands along the Shediac Valley and the Northumberland Strait. They are also found near Bathurst, Caraquet, Shippagan, Lamèque, Miscou harbour, MacGregor and Windsor MalBays, Pokemouche, Tracadie, Tabusintac, Miramichi, Kouchibouguac, Richibucto, Bouctouche, Shediac, Cap-Pele, Shemogue, Cape Jourimain, and Baie Verte.

References

R1: DFO (MPA Laurentian Region) 1998

3.2.1 Striped bass spawning ground in Miramichi

Ecological Features

- Striped bass are known to spawn in the brackish water of the Northwest Miramichi, between 6 km and 17 km upstream of Newcastle[b1] (Figure 3.2.1). Both the bay and the freshwater and saltwater portions of the Miramichi watershed are known spawning grounds for several species such as Atlantic salmon, gaspereau, smooth flounder, tomcod, smelt, blueback herring and American shad [b2] (see appendix).
- The striped bass stock in the Gulf of St. Lawrence, from Perce to Cape Breton, all originates from the southwestern part of the Gulf of St.-Lawrence, and the Miramichi spawning ground is considered the most important, and perhaps the only spawning site.[b3,b4] It is possible, however, that other rivers may be used for spawning by striped bass, since young of the year have been found from Nepisiguit Bay to Cocagne[b9,b10,] while the Tabusintac, Nepisiguit, Kouchibouguac and Richibucto rivers were considered as spawning habitat for striped bass because of the presence of adults during the spawning season [b4]. However, the presence of eggs in these rivers has never been confirmed,[b11] as a number of mature adults were not spawners or migrated to the Miramichi during the same year[b4]. Moreover, there was no evidence of spawning in the rivers sampled, the Kouchibouguac, Richibucto and Hillsborough (PEI) rivers, during the follow-ups[b22]. Mark and recapture study results have shown that the vast majority of marked adults returned to the Miramichi [b23] and spawning in another river system is therefore unlikely[B23]. For now, the Miramichi is the only confirmed striped bass spawning habitat in the southwestern part of the Gulf of St-Lawrence[b7,b8].
- Miramichi striped bass stocks are genetically different from those of the Bay of Fundy. Mitochondrial DNA tests have confirmed this difference[b12] and a nucleus DNA test is currently under way to verify the conclusion[b7]. The presence of two different stocks in the Maritimes had already been highlighted by mark-recapture experiments[b9]and similar research done since then always shows the same results[b6,b18].
- Striped bass are spring spawners (end of May to mid June). They spawn in tidal waters, 2 km upstream of the salt wedge, but in an area reached by the salt wedge [b1]. Salinity measurements in these areas usually show less than 5 ppt near the surface and 10 ppt near the bottom[b1]. Larvae and young-of-the-year (age 0^+) are found in the lower reaches of the river and in the estuary[b5,b13]. Adults migrate for feeding during the summer and fall along the coast of the southeastern Gulf, then migrate back to rivers, including the Miramichi, each winter[b2,b5,b9,b14]. They may be trying to avoid the colder, saltier waters of the Gulf and remain in near-zero temperatures during the cold season[b10,b15]. This overwintering pattern may explain the presence of adult spawners in rivers other

than the Miramichi in the spring[b5], where no spawning activity or eggs have been observed. Neighbouring rivers are also used for overwintering, namely the Kouchibouguac, the Saint-Louis[b16] and the Richibucto[b8], but we lack knowledge about the exact number of rivers and their relative importance.

Vulnerability, threats and human pressure

- The spawning ground in the Miramichi may currently be supporting the entire striped bass population of the southern Gulf[b3,b4]. The species is at the northern limit of its distribution range[b18].
- The Miramichi Bay is also an essential habitat for the growth, spawning migration, and overwintering of all life stages of striped bass. [b2, b5, b9, b14]
- Without having official endangered species status, the striped bass population of the Gulf is very fragile because of its possible dependence on a single spawning ground. In the past, there were probably 5 distinct populations in eastern Canada. There are now only two, one in Miramichi and one in the Bay of Fundy[b7], which is in another biogeographical region. The only other population historically known to have existed further north was in the St. Lawrence River Estuary in Quebec, which is now extinct[b17].
- Striped bass is sensitive to overharvesting because it is fished (by-catch) almost year round by various fishing gear (traps, gillnets, and angling from spring to fall, hoop nets and gillnets in the winter).
- Overharvesting is reinforced by by-catches. For example, before they were automatically re-released, striped bass by-catches during the gaspereau fishery could represent up to 25% of the adult fish population [b5], and during the fall smelt fishery in Miramichi Bay, it can represent between 100,000 and 500,000 striped bass [b18].
- In 1995-1996, the harvesting rate of striped bass was said to be 80% of the stock; on the Atlantic seaboard of the United States, the target rate is 27% and the limit is 33%[b18].
- The major sources of pollution on the Miramichi are mining activities (Heath Steele mine, located on a Northwest Miramichi tributary), pulp and paper mills (REPAP, Eagle, Acadia, Nelson Forest products) and wastewater from towns and villages [b19]. The problems associated with these pollutants are undetermined, but the suspected limiting factors include suspended sediments, sedimentation on the spawning ground and chemical pollution (metal, solvents, organic contaminants, etc.). Wastewater could have an impact on dissolved oxygen (increase in BOD, or biochemical oxygen demand). REPAP has recently improved its water treatment facility and dioxins and furans effluents meet the guidelines since 1995, while suspended sediment criteria were met in 1997[b26].
- From 1920 to 1986, Domtar had a wood treatment facility in Newcastle; the waste was discharged into Chemical Creek, a tributary of the Miramichi [b21]. In 1984, sediment samples taken within a 100-meter radius of the main discharge

channel were heavily contaminated with PAH, dioxins, and furans; a high concentration of these substances were found in the lobster fished in Miramichi Bay in 1983 [b21]. The site has since been cleaned [b8].

- Most towns and villages now have water treatment facilities, but coliform levels remain high and have caused the closure of shellfish harvesting zones in the lower part of the estuary [b21]. In 1998, a new collector was also built at the Strawberry Marsh treatment plant for the north side of the city of Miramichi. Similar projects are being planned in the short term for the south side[b26]. A few houses and cottages only have septic tanks and discharge unclean wastewater in the river and its tributaries [b21].
- There are several former dumpsites in the Miramichi River basin that may be additional sources of pollution due to leaching.
- In 1981 and 1983, a navigation channel was dredged in the Miramichi (6.5×10^6 m^3 of sediments were dredged). The maintenance dredging of this channel is a potential source of habitat degradation. The increased turbidity of the water during dredging is a cause of concern, and the stability of the dumpsites has been questioned. There are three such sites: a relatively stable one in the estuary between Newcastle and Chatham, a second located outside of the barrier islands at the mouth of the Miramichi River and a third one, which is unstable, in the inner bay inside of the barrier islands [b19].
- There are two major ports on the Miramichi River: Newcastle and Chatham. Ore used to be stored at these ports, and produced unknown amounts of pollution from runoff and percolation. This is no longer practised at these sites.
- A large number of adult striped bass are caught and eventually die in nets during the net salmon fishery at Eel Ground [b24].
- Striped bass also get trapped in the nets used for fishing gaspereau near the spawning ground [b24]; the gaspereau fishing season and bass spawning season are essentially at the same time[b18]. Even if bass are released live on site, a mortality rate of approximately 5% is associated with this fishery[b23].
- Striped bass was also traditionally fished through the ice in its overwintering habitats (Miramichi, Richibucto and Kouchibougouac rivers)[b24]. This is no longer allowed, although some poaching has been reported in recent years.
- The REPAP pulp and paper mill is located downstream of the spawning ground.

Socio-economic characteristics

- This is a species of general interest that supported a commercial fishery until 1996. It remains an important game fish even though only catch and release fishing was allowed until March 1999, when striped bass angling was completely closed. In addition, it supported a native fishery.
- Two First Nation reserves are located near the spawning ground: Eel Ground and Red Bank[b24].

- Historically, striped bass was harvested primarily through by-catches by many types of commercial gear used in the gaspereau and smelt fisheries[b20].
- Declared landings vary considerably from year to year, which has led to the belief that the abundance of striped bass fluctuates enormously [b20]. Overfishing is undoubtedly a factor in these fluctuations [b20].
- In 1990, striped bass stocks in the southern Gulf were declared either reduced or decreasing. Conservation measures aimed at limiting mortality by fishing were taken to stop this decrease and to increase the survival of the spawners [b20].
- The commercial fishing of striped bass was closed permanently in March 1996 by an amendment to the Fisheries Act prohibiting the sale of wild striped bass in the Maritime Provinces [b20].
- Following this closure, tolerance limits for by-catch were established, given the difficulty of distinguishing striped bass of less than 35 cm in length among large quantities of gaspereau of the same size [b20].
- First Nations have fished striped bass for food, social and traditional purposes; the allowable catches in the agreements were based on community needs [b20]. Catches by native fishers are unknown but are supposed to be lower than commercial landings [b20]. The commercial and sports fisheries are closed, so the only known landings come from the native fishery.
- Sport fishing was limited to catch and release only in 1996 [b20]. In March 1999, the catch and release fishery was also closed.
- Prospects of an increase in stocks in the immediate future are low [b20].
- Commercially harvested species in the area include gaspereau in May and June (6 fishers), eel between January and December (2 fishers use nets, 20 use spears), Atlantic salmon between June and September (1 gill net), black salmon in April and May (100 fishers/day), shad between June and September (1) and trout between May and September (unknown effort)[b24].

Support, favourable and unfavourable factors

- Support for the protection of striped bass could be high because of its importance and popularity among anglers [b20].
- Support for the protection of the area (special status or management) may be enhanced if all stakeholders are aware that it may be the only spawning ground in the southern Gulf [b24].
- The Miramichi watershed is an Environment Canada "ACAP" site (Atlantic Canada Coastal Action Program), which means it is already benefitting from integrated management efforts. The *MREAC* (*Miramichi River Environmental Assessment Committee*) has been working to restore the ecological integrity of the ecosystem since 1989.
- Juveniles from the Miramichi stock may be used in a pilot project aimed at re-introducing striped bass in the St. Lawrence Estuary, in areas that historically

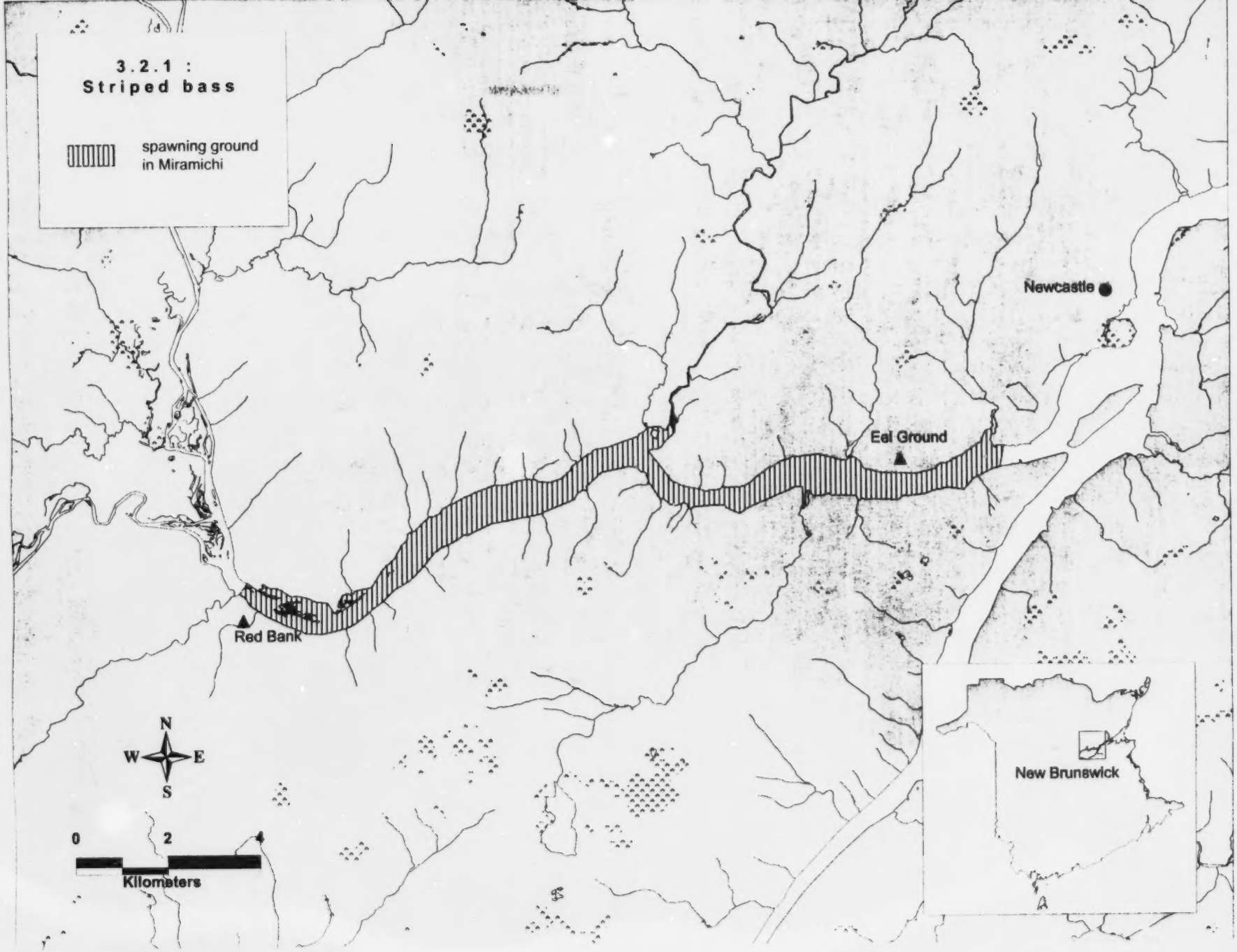
supported striped bass stocks. A feasibility study to re-introduce a self-sustaining bass population, as part of phase 2 of Vision 2000, the Management Plan of the St. Lawrence Action Plan, underscores the fact that this re-introduction could help to restore the original biodiversity of this habitat[b25].

Other associated essential habitats

- The Miramichi basin is a habitat of interest for the following species: herring (3.2.7), lobster (3.3.3), American oyster (3.4.2), and quahog (3.4.5), as well as blueback herring, American shad, eel, smelt, herring, gaspereau, sand lance, Atlantic mackerel, white hake, smooth flounder, winter flounder, Atlantic tomcod, surf clam, blue mussel, soft shell clam, aquatic birds and salmon (Appendix).
- Striped bass is also associated with Miramichi Bay (Appendix).

References

B1 : Robichaud-LeBlanc et al., 1996
B2 : Hanson and Courtenay, 1995
B3 : Chaput and Randall, 1990
B4 : Bradford, Chaput and Tremblay, 1995
B5 : Bradford, Robichaud and Courtenay, 1995
B7 : R Bradford, p.c. 1999
B8 : S. Courtenay, p.c. 1999
B9 : Rulifson and Dadswell, 1995
B10 : Bradford and Tremblay, 1998
B11 : Robinson et al., 1998
B12 : Wirgin et al., 1993
B13 : Locke and Courtenay, 1995
B14 : Hogans and Melvin, 1984
B15 : Drinkwater et al., 1993 [in b5]
B16 : Bradford et al., 1997
B17 : Beaulieu et al., 1990
B18 : Bradford and Chaput, 1998
B19 : Buckley, 1995
B20 : DFO (striped bass) 1998
B21 : Eaton and Gray, 1994
B22 : G. Chaput, p.c., 1999
B23 : Bradford et al., 1998
B24 : Fishery officers, Miramichi, p.c. 1999
B25: Comité de travail, Faune et parcs, Québec, 1999
B26: H. Collins, p.c. 2000


3.2.1 :
Striped bass
spawning ground
in Miramichi
Newcastle
Eel Ground
Red Bank
N
W
E
S
0
2
4
Kilometers
New Brunswick

3.2.2 Capelin spawning ground on Miscou Bank

Ecological Features

- Spawning grounds on Miscou Bank[c1, c2, c3] (Figure 3.2.2).
- Main known capelin spawning ground, but boundaries are approximate and more spawning grounds likely exist near the east coast of New Brunswick. Capelin stock distribution was in expansion in the southern Gulf between 1990 and 1997, but the reverse occurred in 1998 and other changes may occur in the coming years [c2]. The stock is more abundant in the northern part of the Gulf [c2].
- The Miscou Bank is a very productive habitat for the growth of several species of fish.
- Spawning site for a number of fish species, including mackerel and cod.
- Migration route for certain whales, which use it as a feeding ground.

Vulnerability, threats and human pressure

- Capelin is sensitive to water temperature fluctuations (e.g. expansion to the south caused by a cooling of Gulf waters [c2, c3]), and is prey for several species of fish, aquatic birds and marine mammals. Capelin stocks are therefore likely to fluctuate along with the stocks of these species.
- Harvesting and overfishing species that are the prey of other commercial species can affect recruitment. Fishers and scientists worry that the growth of the capelin fishery in the Gulf could hurt the recovery of the Atlantic cod stocks by eliminating one of its important food sources[c4]. It should be noted, however, that commercial catches of capelin represent only a small proportion of the mortality caused by its numerous predators (marine mammals, aquatic birds and piscivorous fish) [c1].
- There are whale watching and sea tours on Miscou Island Point [c6].
- Start of experimental trawl fishery for capelin and other species in 1998, which was to continue in 1999[c7].

Socio-economic characteristics

- Capelin is a commercially harvested species of economic interest.
- In the mid-1800's, the decline of Atlantic cod stocks was linked to the decline of its main preys: herring and capelin[c8].
- The capelin fishery expanded quickly at the end of the 1970s with the arrival of an Asian market for roe [c9].
- Species harvested in the area are lobster in May and June (8 fishers), herring between August and October (575 fishers with fixed gear) and between August and October (20 with mobile gear), capelin in June (2 fishers, pilot project), mackerel between June and August (5000 angler/days) and between May and

September (100 fishers with drift nets), groundfish in June (5 fishers with mobile gear) and between August and December (160 fishers with fixed gear) and between August and November (500 recreational fisher/days), halibut between June and August (10 fishers), flounder between April and December (150 fishers with fixed gear)[c11].

- Capelin catches vary enormously from year to year according to demand; they were over 200,000 kg in 1985, fell to a low of 6577 kg in 1997 and in 1998, reached 756,716 kg [c10].
- The capelin fishery was valued at $75,074 in 1998 [c10](2 fishers).

Support, favourable and unfavourable factors

- Cod fishers could be favourable to the protection of this habitat because of the importance of capelin to the latter species.
- This habitat is also targeted by a study of the Laurentian region.
- Since whales prey on capelin, whale watching tour operators could also favour the protection of this habitat.
- The Canadian Wildlife Service is also interested in this habitat because of the high number of bird colonies found in the area. Northern gannet use this site as feeding ground.
- This habitat is part of a larger area that has been nominated as an "Important Bird Area (IBA)" because it is considered important for a number of coastal bird species (Northern gannet, scoters and murres).

Other associated essential habitats

- Miscou Bank is a habitat of interest for the following species: herring (3.2.5 and 3.2.6) and the Stimpson's surf clam (3.4.4), Atlantic cod (3.2.14); also Atlantic halibut, Atlantic mackerel, Atlantic cod, sea scallop and harbor porpoise (Appendix).
- The capelin is not associated with other habitats of interest.

References

C1: F. Grégoire, p.c. 1999

C2: DFO (capelin), 1997

C3: Grégoire et al., 1997

C4: White and John, 1997

C5: Hunter, 1975

C6: Department of Economic Development and Tourism, 1998

C7: E. Ferguson, p.c. 1999

C8: Perley, 1852

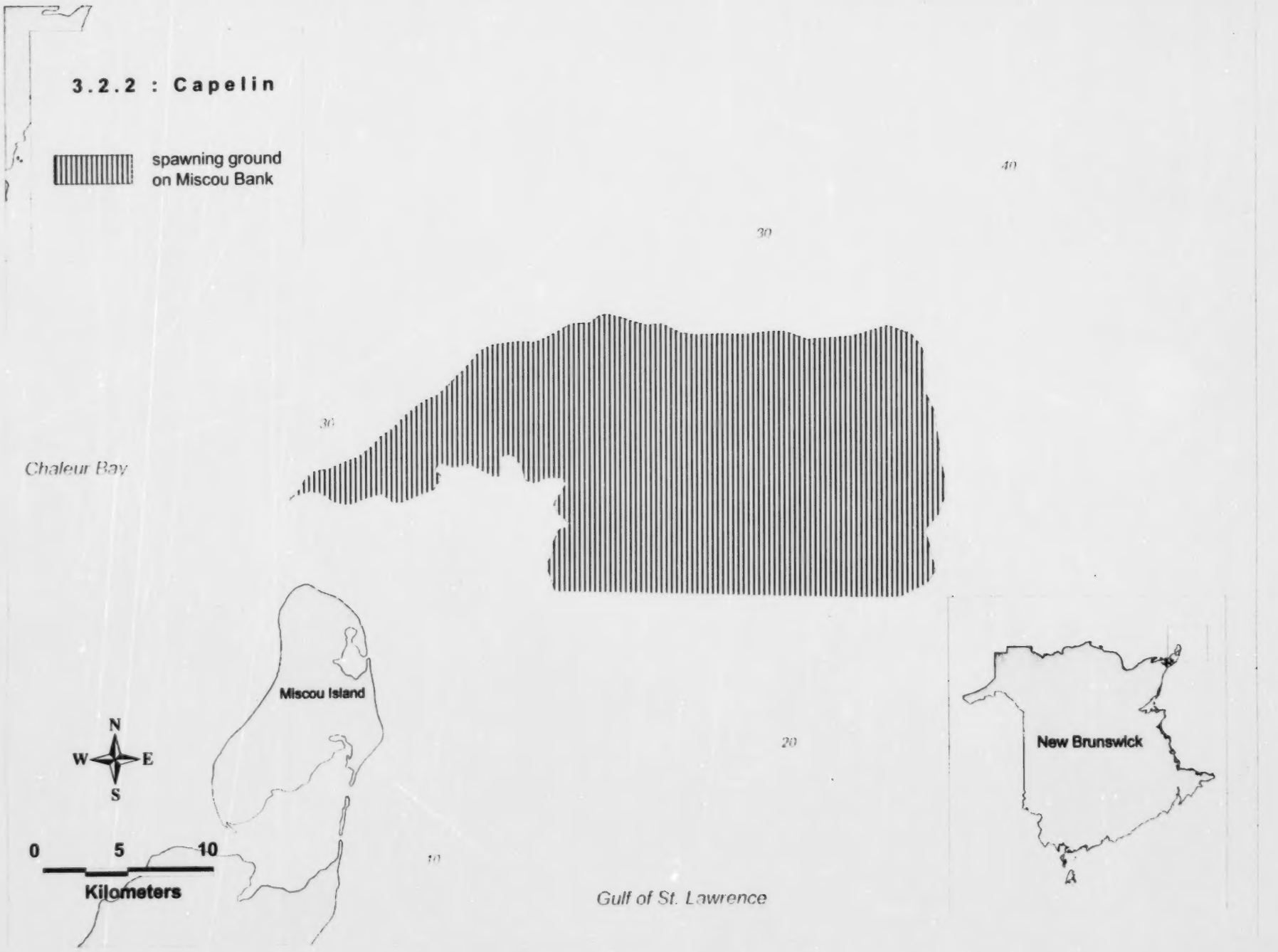
C9: DFO (capelin), 1998

C10: DFO Statistics, 1998

C11: Fishery officers: Shippagan and Laurentian Region, p.c. 1999.

3.2.2 : Capelin

spawning ground on Miscou Bank



3.2.3 Atlantic herring nursery and overwintering area in Chaleur Bay

Ecological Features

- Concentration of juvenile Atlantic herring (0-2 years) in the western part of Chaleur Bay (Figure 3.2.3).
- It is the main area with high juvenile concentration[g1,g2,g3] near the east coast of New Brunswick. The other major habitat is located in Shediac Valley[g1,g3,g4](3.2.6). A third habitat of lesser importance is located in the current gyre near Baie Verte[g2,g4](see appendix).
- This habitat is occupied mostly by spring-spawned herring,[g1,g2,g3,g4] .Those 0^+ are located at depths of less than 15.5 fathoms (25 m)[g2,g4], while 1^+ and 2^+ fish are found between 12.5 and 31 fathoms (20 m and 50 m)[g1,g4] and 3^+ are found with the adults at depths greater than 31 fathoms (50 m)[g1,g3].
- Chaleur Bay, the western part in particular, is highly productive and is characterised by seasonal migrations of marine mammals, aquatic birds, fish (mackerel, salmon, tuna, etc.) and crustaceans (snow crab, etc.). There is a high species diversity of benthic marine algae, including large kelp beds and more than 250 species of benthic organisms which are found in mudflats in the nearshore zone (mostly molluscs, amphipods and echinoderms)[g5].

Vulnerability, threats and human pressure

- The Chaleur Bay nursery area may play a substantial role in maintaining the spring spawner herring stock, even if the most abundant population[g6] and the main spawning habitats are found farther south[g1].
- There are a number of industries located on the northern and southern banks of the Chaleur Bay basin. Pulp and paper mills, mines, a smelter, a fertilizer plant, thermal power plants as well as a number of fish processing plants are located near the area[g8,g9,g10].
- Chaleur Bay as a whole is considered to be healthy, although there are local pollution problems, especially between Bathurst and Dalhousie[g8].
- The mining industry is a significant source of pollution. The Brunswick and Caribou mines, which process zinc, copper and lead, are located near the Little River, which empties into the Bathurst and Forty Miles Creek harbours. In the early eighties, there were problems with acidic water and heavy metal contamination[g9]. Conditions have improved since 1982, following the construction of a separate water treatment plant for the mine. However, in spite of these efforts, there are still some problems with low pH, associated with a by-product of partially oxidised sulphur compounds called sulfosalts. The bacteria that oxidise these salts are the only living organisms in the Little River at this time. The problem is particularly difficult to resolve because the biological

oxidation process is still active after the wastewater has spilled into the Little River[911].

- The Belledune smelter produces effluents with toxic heavy metal content such as cadmium. The lobster fishery in Belledune harbour had to be closed on a number of occasions because of this problem[99,911]. In 1981, effluent cadmium concentrations had decreased by as much as 97%. In 1986, however, an increase in Cd concentrations was noticed in lobster, and concentrations remained high in 1987 and 1988. This contamination was caused by improper land filling techniques for contaminated wastes and a problem with one of the effluent pipes in the recycling system. The broken pipe was replaced in 1989, but it is still unknown if the measures taken were effective[911]. The inner harbour is still closed to lobster fishing[921].
- The fertilizer plant in Belledune discharges raw toxic effluent with low pH and high concentrations of fluoride and suspended sediment, with traces of nitrotoluene and other compounds, including heavy metals[910]. This plant is presently closed[911].
- PCI Chemicals in Dalhousie produces chlorine and caustic soda used by pulp and paper mills. This plant uses a mercury cathode process that, between 1976 and 1987, was responsible for discharging 5.3 tons of mercury into the environment[911].
- Pulp and paper mills reject liquid and gas effluents, as well as contaminated solid wastes[99]. It should be noted that the Atholville and Dalhousie plants have improved their treatment facilities in the last 5 years.
- Pulp and paper mills produce more effluents (consisting of dissolved organic and inorganic compounds, suspended matter) than any other industry in the area[911].
- The Dalhousie thermal power plant uses 20 000 tonnes of orimulsion per year. This oil-based emulsion in water has high polycyclic aromatic hydrocarbon (PAH) concentrations and may threaten benthic organisms, including scallop beds in the bay, if a spill occurs[920].
- Fish plants located in the eastern portion of the bay produce effluents with high Biological Oxygen Demand (BOD). The effluents also have high bacterial counts and the plants also produce large quantities of solid wastes, which must be either dumped in the bay or on land[911].
- There are two marinas located in the bay, one in Bathurst (100 boats) and one in Dalhousie (30 boats)[912].
- Two major ports are also located in the area: Dalhousie (second largest port in New Brunswick) and Belledune (third largest port in the province). There are also a number of smaller fishing wharves.
- Tourism is also important in Dalhousie (sea kayak, boat tours and ferry crossing to Miguasha, Qc), in Caraquet (boat tours, kayak and whale watching), and in Bathurst (excursions on the Nepisiguit River, boat tours)[913].

- There are beaches in Dalhousie, Charlo, Jacquet River, Belledune, Petit-Rocher, Beresford and Bathurst[913].

Socio-economic characteristics

- Herring is a commercially harvested species of high economic interest.
- Historically, the most profitable fisheries in the Gulf were herring, cod and mackerel[914].
- There are two First Nation communities on the south shore of Chaleur Bay: Eel River Bar and Pabineau Falls, and two other on the north shore: New Richmond and Maria.
- Herring landings increased in 1996 and 1997 for the Gulf of St. Lawrence as a whole[916].
- Commercially harvested species include: Lobster in May and June (166 fishers), herring in April and May (25) and again between July and September (126), mackerel between May and August (97) and in August and September (1000), scallop between May and October (50 recreational fishers) and between May and September (33 commercial fishers), smelt between October and February (71 fishers with nets and box nets) and between December and February (1880 recreational fishers), rock crab in May and June and between August and October (25), sea urchin in April and in September and October (3), groundfish between April and October (10 fishers with fixed gear and 1 with mobile gear) and between August and November (2250 recreational fishers), surf clams between April and June and between September and December (100), blue mussel throughout the year (400 harvesters and one grower) and soft shell clam between April to December (1000 recreational harvesters)[919].
- 3500 inshore fishing licenses and 6 seining licenses are issued for herring in the Gulf[915].
- In eastern New Brunswick, total landings of herring reached 29,789,640 kg in 1998, with a commercial value of $4,812,194[916].

Support, favourable and unfavourable factors

- A Laurentian Region DFO study proposed this site, to recognize the importance of this productive and diverse habitat, underline its fragility against numerous sources of contamination, and to support the protection of the herring spawning grounds, kelp and eelgrass beds, snow crab habitats and seabird habitats (geese, scoter, Harlequin duck).
- This site covers an area with multiple provincial jurisdictions.
- The Quebec portion of Chaleur Bay has been named a Priority Intervention Zone under the St. Lawrence Vision 2000 Action Plan, which means that a group is actively working on the ecological rehabilitation of the area.

Other associated essential habitats

- The western part of Chaleur Bay constitutes a habitat of interest for the following species: herring (New Mills spawning ground, 3.2.4, Nepisiguit spawning ground), sea scallop (3.4.6), kelp beds (3.1.3), mackerel, cod, soft-shell clam, sea urchin and aquatic birds (see appendix).
- Atlantic herring is associated with the following habitats of interest: New Mills (3.2.4), Miscou Bank (3.2.5), Shediac Valley (3.2.6), Miramichi and Escuminac (3.2.7), Richibucto (3.2.8), Cap Pelé (3.2.9) and Murray Beach (3.2.10), as well as Nepisiguit Bay, Caraquet, western shores of Lamèque and Miscou islands, Miramichi, Kouchibouguac, Richibucto, Bouctouche, Cocagne, Shediac Bay, Cape Tormentine and Baie Verte (see Appendix).

References

G1: C. LeBlanc, p.c., 1999

G2: Dupuis et al., 1997

G3: LeBlanc et al.,1998

G4: LeBlanc et al., 1997

G5 : DFO (MPA for Laurentian Region), 1998

G6 : Claytor et al., 1998

G8 : Hildebrand, 1984

G9 : Breau, 1998

G10 : Gagnon et al., 1997

G11 : Eaton and Gray, 1994

G12 : Washburn and Gillis, 1989

G13: NB Department of Tourism and Economic Development, 1998

G14 : Perley, 1852

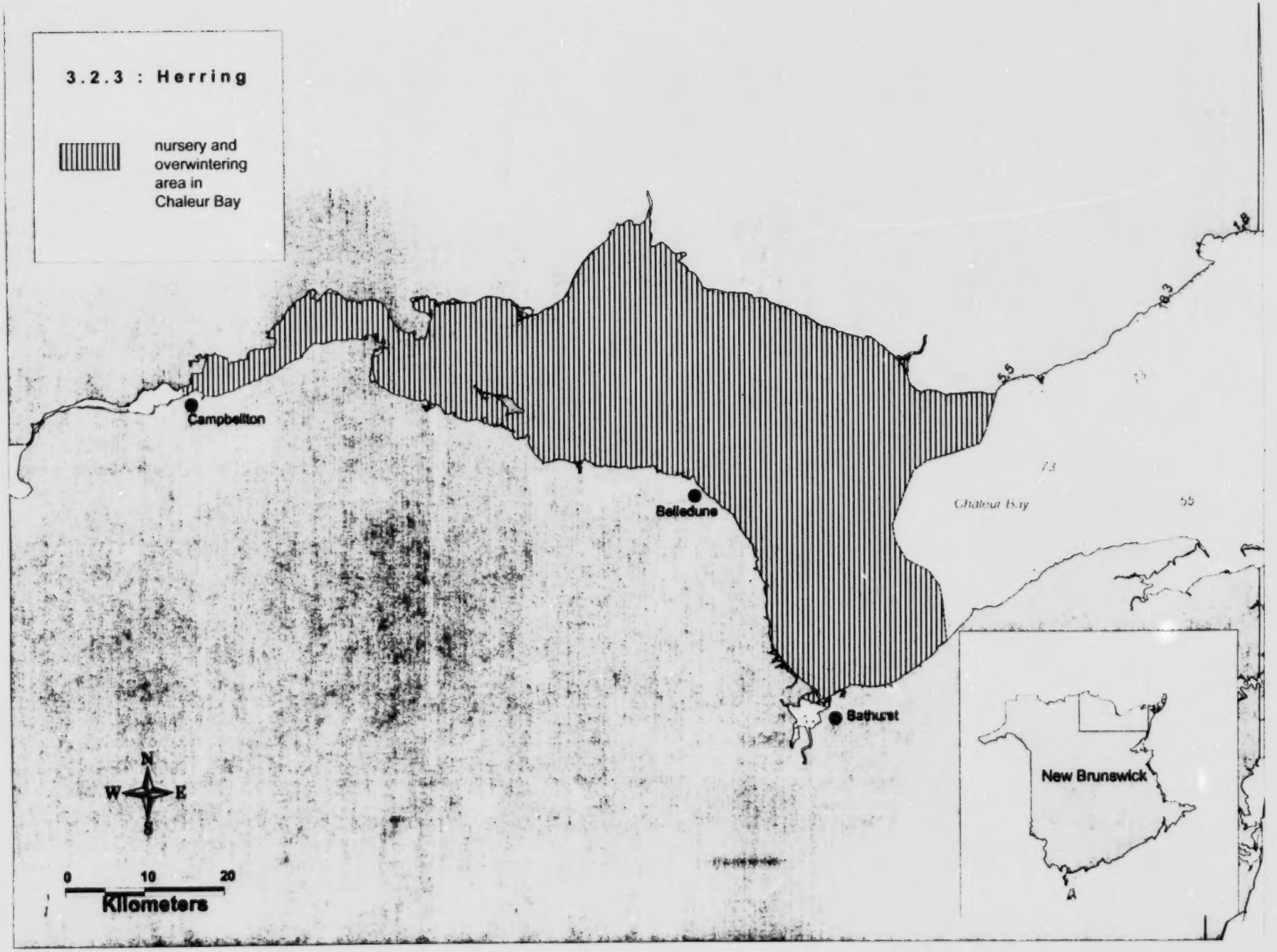
G15 : DFO(Herring), 1998

G16 : DFO Statistics, 1998

G19 : DFO fishery officers, Dalhousie, Bathurst and Laurentian Region, p.c. 1999

G20 : Federal-provincial-territorial advisory committee, 1999

G21 : E. Ferguson, p.c. 1999


3.2.3 : Herring
nursery and overwintering area in Chaleur Bay
Campbellton
Belledune
Bathurst
Chaleur Bay
New Brunswick
N
W
E
S
0
10
20
Kilometers

3.2.4 Atlantic herring spawning ground in New Mills (Chaleur Bay)

Ecological Features

- Spring spawning habitat for Atlantic herring located south of Heron Island (western part of Chaleur Bay), along the coast between LaRoche Point and the New Mills wharf[g19] (figure 3.2.4). The spawning grounds are usually located at depths of less than 2 fathoms (3,2m)[g6].
- It is the only known spring spawning ground located in the New Brunswick portion of Chaleur Bay[g1]. There are some smaller fall spawning sites in Nepisiguit Bay, Caraquet Bay and west of Lamèque and Miscou islands (see appendix). The most important spring spawning ground near the east coast of New Brunswick is located in Miramichi and Escuminac[g1] (3.2.7).
- Chaleur Bay, especially the western part, is highly productive and is characterised by seasonal migrations of marine mammals, aquatic birds, fish (mackerel, salmon tuna, etc.) and crustaceans (snow crab, etc.). There is a high diversity of benthic marine algae, including large kelp beds. More than 250 species of benthic organisms are found in the nearshore zone (mostly molluscs, amphipods and echinoderms)[g5].
- This is also an important area for the reproduction of flounder (sp.)[g19].

Vulnerability, threats and human pressure

- Although the spring herring stocks are more abundant[g6] and mainly spawn farther south[g1], New Mills is known as the main spawning ground in the bay for spring stock.
- The spring spawning stock is in decline in Chaleur Bay since 1994[g1], although the largest population near Escuminac is stable[g1,g6].
- There are a number of industries located on the northern and southern banks and throughout the Chaleur Bay basin. Pulp and paper mills, mines, a smelter, a fertilizer plant, thermal power plants as well as a number of fish processing plants are located near the area[g8,g9,g10].
- Chaleur Bay as a whole is considered to be healthy, although there are local pollution problems, especially between Bathurst and Dalhousie[g6].
- The mining industry is a significant source of pollution. The Brunswick and Caribou mines, which process zinc, copper and lead, are located near the Little River, which empties into the Bathurst and Forty Miles Creek harbours. In the early eighties, there were problems with acidic water and heavy metal contamination[g9]. Conditions have improved since 1982, following the construction of a separate water treatment plant for the mine. However, in spite of these efforts, there are still some problems with low pH, associated with a by-product of partially oxidized sulphur compounds called sulfosalts. The bacteria

that oxidize these salts are the only living organisms in the Little River at this time. The problem is particularly difficult to resolve because the biological oxidation process is still active after the wastewater has spilled into the Little River[911].

- The Belledune smelter produces effluents with toxic heavy metal content such as cadmium. The lobster fishery in Belledune harbour had to be closed on a number of occasions because of this problem[99,911]. In 1981, effluent cadmium concentrations had decreased by as much as 97%. In 1986, however, an increase in Cd concentrations was noticed in lobster, and concentrations remained high in 1987 and 1988. This contamination was caused by improper land filling techniques for contaminated wastes and a problem with one of the effluent pipes in the recycling system. The broken pipe was replaced in 1989, but it is still unknown if the measures taken were effective[911]. The inner harbour is still closed to lobster fishing[921].
- The fertilizer plant in Belledune discharges raw toxic effluent with low pH and high concentrations of fluoride and suspended sediment, with traces of nitrotoluene and other compounds, including heavy metals[911]. This plant is presently closed[921].
- PCI Chemicals in Dalhousie produces chlorine and caustic soda used by pulp and paper mills. This plant uses a mercury cathode process that, between 1976 and 1987, was responsible for discharging 5.3 tons of mercury into the environment[911].
- Pulp and paper mills discharge liquid and gas effluents, as well as contaminated solid wastes[99]. It should be noted that the Atholville and Dalhousie plants have improved their treatment facilities in the last 5 years.
- Pulp and paper mills produce more effluents (consisting of dissolved organic and inorganic compounds, suspended matter) than any other industry in the area[911].
- The Dalhousie thermal power plant uses 20 000 tonnes of orimulsion per year. This oil-based emulsion in water has high polycyclic aromatic hydrocarbon (PAH) concentrations and may threaten benthic organisms, including scallop beds in the bay, if a spill occurs[920].
- Fish plants located in the eastern portion of the bay produce effluents with high Biological Oxygen Demand (BOD). The effluents also have high bacterial counts and the plants also produce large quantities of solid wastes, which must be either dumped in the bay or on land[911].
- There are two marinas located in the bay, one in Bathurst (100 boats) and one in Dalhousie (30 boats)[912].
- Two major ports are also located in the area: Dalhousie (second largest port in New Brunswick) and Belledune (third largest port in the province). There are also a number of smaller fishing wharves.

- Tourism is also important in Dalhousie (sea kayak, boat tours and ferry crossing to Miguasha), in Caraquet (boat tours, kayak and whale watching) and in Bathurst (excursions on the Nepisiguit River, boat tours)[913].
- A ferry travels between New Mills and Heron Island.

Socio-economic characteristics

- Herring is a commercially harvested species of high economic interest.
- Historically, the most profitable fisheries in the Gulf were herring, cod and mackerel[914].
- There are two First Nation communities on the south shore of Chaleur Bay: Eel River Bar (across from Heron Island) and Pabineau Falls and two other on the north shore: New Richmond and Maria.
- The area near New Mills was historically known as an excellent fishing site for herring[914].
- Herring landings increased in 1996 and 1997 for the Gulf of St. Lawrence as a whole[916].
- Commercially harvested species include: herring in April and May (28 fishers), lobster in May and June (23), and smelt between October and March (6)[919].
- 3500 inshore fishing licenses and 6 seining licenses are issued for herring in the Gulf[915].
- In eastern New Brunswick, total landings of herring reached 29 789 640 kg in 1998, with a commercial value of $4 812 194[916].

Support, favourable and unfavourable factors

- A number of fishers from Caraquet operate in this area.[919].
- Local fishers may be favourable to the idea of protecting this habitat because they were worried about the health of the stocks as early as 10 years ago[919].

Other associated essential habitats

- Heron Island is also a habitat of interest for the following species: herring (nursery area in the western part of Chaleur Bay, 3.2.3) and Atlantic mackerel (see appendix).
- Atlantic herring is also associated with the following habitats of interest: western part of Chaleur Bay (3.2.3), Miscou Bank (3.2.5), Shediac Valley (3.2.6), Miramichi and Escuminac (3.2.7), Richibucto (3.2.8), Cap Pelé (3.2.9) and Murray Beach (3.2.10), as well as Nepisiguit Bay, Caraquet, western shores of Lamèque and Miscou islands, Miramichi, Kouchibouguac, Richibucto, Bouctouche, Cocagne, Shediac Bay, Cape Tormentine and Baie Verte (see Appendix).

References

G1: C. LeBlanc, p.c. 1999

G2: Dupuis et al., 1997

G3: LeBlanc et al., 1998

G4: LeBlanc et al., 1997

G5: DFO (MPA for Laurentian Region), 1998

G6: Claytor et al., 1998

G8: Hildebrand, 1984

G9: Breau, 1998

G10: Gagnon et al., 1997

G11: Eaton and Gray, 1994

G12: Washburn and Gillis, 1989

G13: NB Department of Tourism and Economic Development, 1998

G14: Perley, 1852

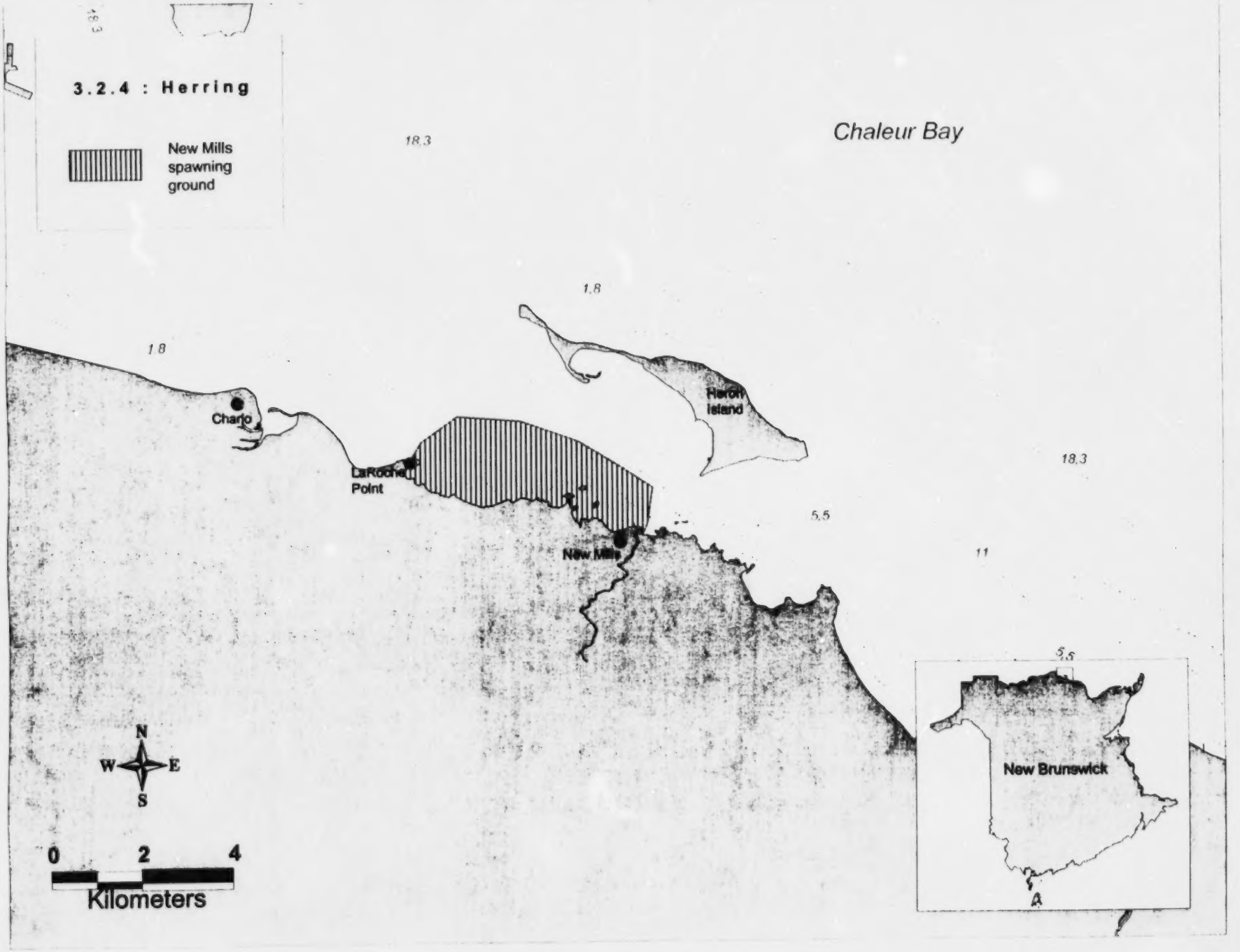
G15: DFO(Herring), 1998

G16: DFO Statistics, 1998

G19: DFO Fishery officers, Dalhousie, p.c. 1999

G20: Federal-provincial-territorial consultation committee, 1999

G21: E. Ferguson, p.c. 1999


3.2.4 : Herring
New Mills spawning ground
Chaleur Bay
18.3
1.8
1.8
Charlo
Heron Island
LaRochelle Point
New Mills
18.3
5.5
11
5.5
N
W
E
S
0
2
4
Kilometers
New Brunswick

3.2.5 Atlantic herring spawning ground on Miscou Bank

Ecological Features

- Spawning ground for fall herring on Miscou Bank (Figure 3.2.5). Fall spawning grounds are usually located at depths between 2 and 10 fathoms (16 m)[96].
- Main fall herring spawning ground. The second largest habitat for fall spawners is located in the Miramichi Bay and Escuminac[91](3.2.7).
- This habitat also overlaps parts of the Shediac Valley nursery area for herring (3.2.6).
- The spawning area is located along Miscou Bank, which is a very productive area used as a nursery by a number of fish species.
- Breeding area for a number of fish species, including cod and mackerel.
- Migration route for certain whales, which use it as a feeding ground.

Vulnerability, threats and human pressure

- The Chaleur Bay fall stock, which is the largest herring stock off the eastern New Brunswick coast,[91,98] is decreasing.
- A number of fishing wharves are located in close proximity[917].
- Whale watching and boat cruises are carried out in the area[913].

Socio-economic characteristics

- Herring is a commercially harvested species of economic interest.
- Historically, the most profitable fisheries in the Gulf were herring, cod and mackerel[914].
- 3500 inshore fishing licenses and 6 seining licenses are issued for herring in the Gulf as a whole[915].
- Commercially harvested species include: lobster in May and June (12), herring between April and July (20 fishers with mobile gear) and in April and May and between August and October (575 fishers), capelin in June (2), mackerel in July and August (500 angler/days) and between May and August (50 fishers with fixed gear), groundfish between May and December (1 with mobile gear and 160 with fixed gear) and between August and November (500 angler/days), and halibut in July (10 fishers)[919].
- In eastern New Brunswick, total landings of herring reached 29 789 640 kg in 1998, with a commercial value of $4 812 194[916].

Support, favourable and unfavourable factors

- This habitat is also targeted by a study of the Laurentian region [922].

- Canadian Wildlife Service is also interested in this habitat because of the high number of shorebirds and seabirds found in the area. Northern gannets use this site as a feeding ground.
- This habitat is part of a larger area that has been nominated as an "Important Bird Area (IBA)" because it is considered important for a number of coastal bird species.

Other associated essential habitats

- Miscou Bank is a habitat of interest for the following species: capelin (3.2.2), herring (Shediac Valley, 3.2.6), Stimpson's surf clam (3.4.4), Atlantic cod (3.2.14), and sea scallop (3.4.7), as well as halibut, Atlantic mackerel, Atlantic cod, sea scallop, sea urchin, and harbour porpoise (see appendix).
- Atlantic herring is also associated with the following habitats of interest: western part of Chaleur Bay (3.2.3), New Mills (3.2.4), Shediac Valley (3.2.6), Miramichi and Escuminac (3.2.7), Richibucto (3.2.8), Cap Pelé (3.2.9) and Murray Beach (3.2.10), as well as Nepisiguit Bay, Caraquet, western shores of Lamèque and Miscou islands, Miramichi, Kouchibouguac, Richibucto, Bouctouche, Cocagne, Shediac Bay, Cape Tormentine and Baie Verte (see Appendix).

References

G1: C. LeBlanc, p.c., 1999

G6: Claytor et al., 1998

G13: NB Department of Tourism and Economic Development, 1998

G14: Perley,1852

G15: DFO(Herring), 1998

G16: DFO Statistics, 1998

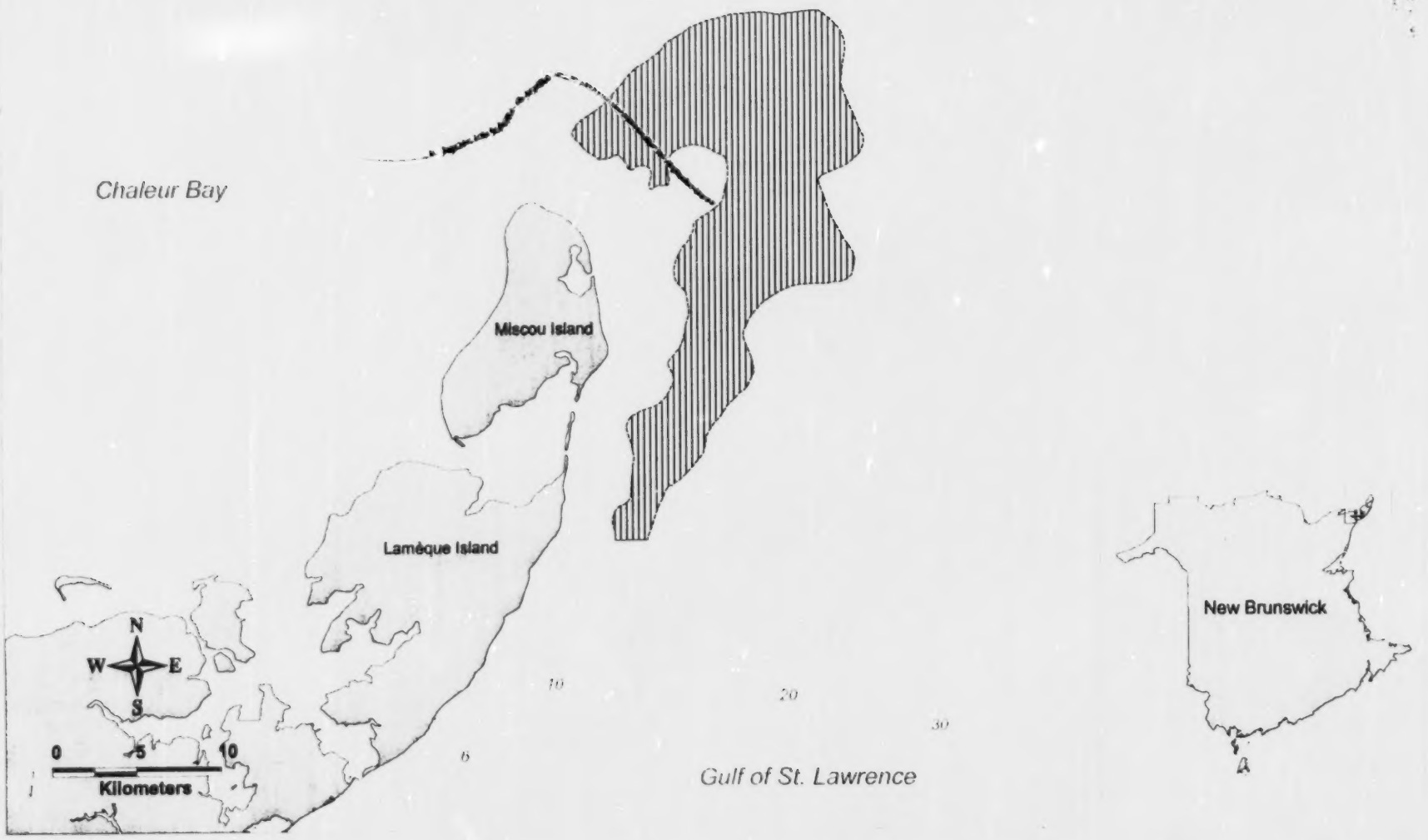
G17: Hunter, 1975

G19: DFO Fishery officers, Shippagan and Laurentian Region, p. c.

G22: DFO, 1998f

3.2.5 : Herring

spawning ground
on Miscou Bank



3.2.6 Atlantic herring nursery and overwintering area in Shediac Valley

Ecological Features

- High concentrations of juvenile Atlantic herring in Shediac Valley (Figure 3.2.6). The boundaries of this essential habitat are approximate and depend on sampled areas (e.g. shallower waters were usually not sampled).
- Second largest concentration of juveniles[g1,g3,g4], the largest concentration being found in Chaleur Bay[g1,g2,g3] (3.2.3), with a smaller site in the current gyre near Baie Verte.[g2,g4] (see appendix).
- They are mostly spring spawned juveniles[g3]; those of 0^+ are at depths less than 15.5 fathoms (25 m)[g2, g4], while 1^+ and 2^+ are usually between 12.5 and 31 fathoms (20 and 50 m)[g1, g4] and 3^+ are with the adults at depths greater than 31 fathoms (50 m)[g1,g3].
- Juvenile concentrations are higher in the southern part of the valley [g4], near a current gyre at the entrance to the Northumberland Strait[g7].
- Shediac Valley is a highly productive area, containing the main nursery area for juvenile Atlantic cod (3.2.13)[g23].

Vulnerability, threats and human pressure

- The Shediac Valley nursery, along with the one in Chaleur Bay, maintains the spring herring stock, and is the main known nursery area for fall juveniles [g3] near the eastern New Brunswick coast.
- There is trawling (groundfish) and dragging (scallops) in this sector[g19]. Both could damage the herring resource, but dragging is thought to have greater adverse effects.

Socio-economic characteristics

- Herring is a commercially harvested species of high economic interest.
- Historically, the most profitable fisheries in the Gulf were herring, cod and mackerel[g14].
- Commercially harvested species include: lobster in May and June (754 fishers), and in August and September (132 fishers), scallop between August and October (247), groundfish between June and September (10 fishers with mobile gear), and between April and December (82 with fixed gear) and between August and November (450 angler/days), mackerel between May and August (330 commercial fishers) and in July and August (525 angler/days), herring between July and September (645), and in April and May (220), capelin in July and August (2), and rock crab in May and June and between August and October (18)[g19].

- 3500 inshore fishing licenses and 6 seining licenses are issued for herring in the Gulf as a whole[915].

Support, favourable and unfavourable factors

- This site covers an area with multiple provincial jurisdictions.

Other associated essential habitats

- Shediac Valley is a habitat of interest for the following species: capelin (3.2.2), Atlantic herring (Miscou Bank, 3.2.5, Miramichi and Escuminac, 3.2.7 spawning grounds), Atlantic mackerel (3.2.11), Atlantic cod (3.2.13 and 3.2.14), lobster (3.3.3) and sea scallop (3.4.7 and 3.4.8) as well as Atlantic cod, halibut, sea scallop, winter flounder, sea scallop and harbour porpoise (see appendix).
- Atlantic herring is also associated with the following habitats of interest: western part of Chaleur Bay (3.2.3), New Mills (3.2.4), Miscou Bank (3.2.5), Miramichi and Escuminac (3.2.7), Richibucto (3.2.8), Cap Pelé (3.2.9) and Murray Beach (3.2.10), as well as Nepisiguit Bay, Caraquet, western shores of Lamèque and Miscou islands, Miramichi, Kouchibouguac, Richibucto, Bouctouche, Cocagne, Shediac Bay, Cape Tormentine and Baie Verte (see Appendix).

References

G1 : C. LeBlanc, p.c., 1999

G2: Dupuis et al., 1997

G3: LeBlanc et al., 1998

G4: LeBlanc et al., 1997

G7: Lauzier, 1965

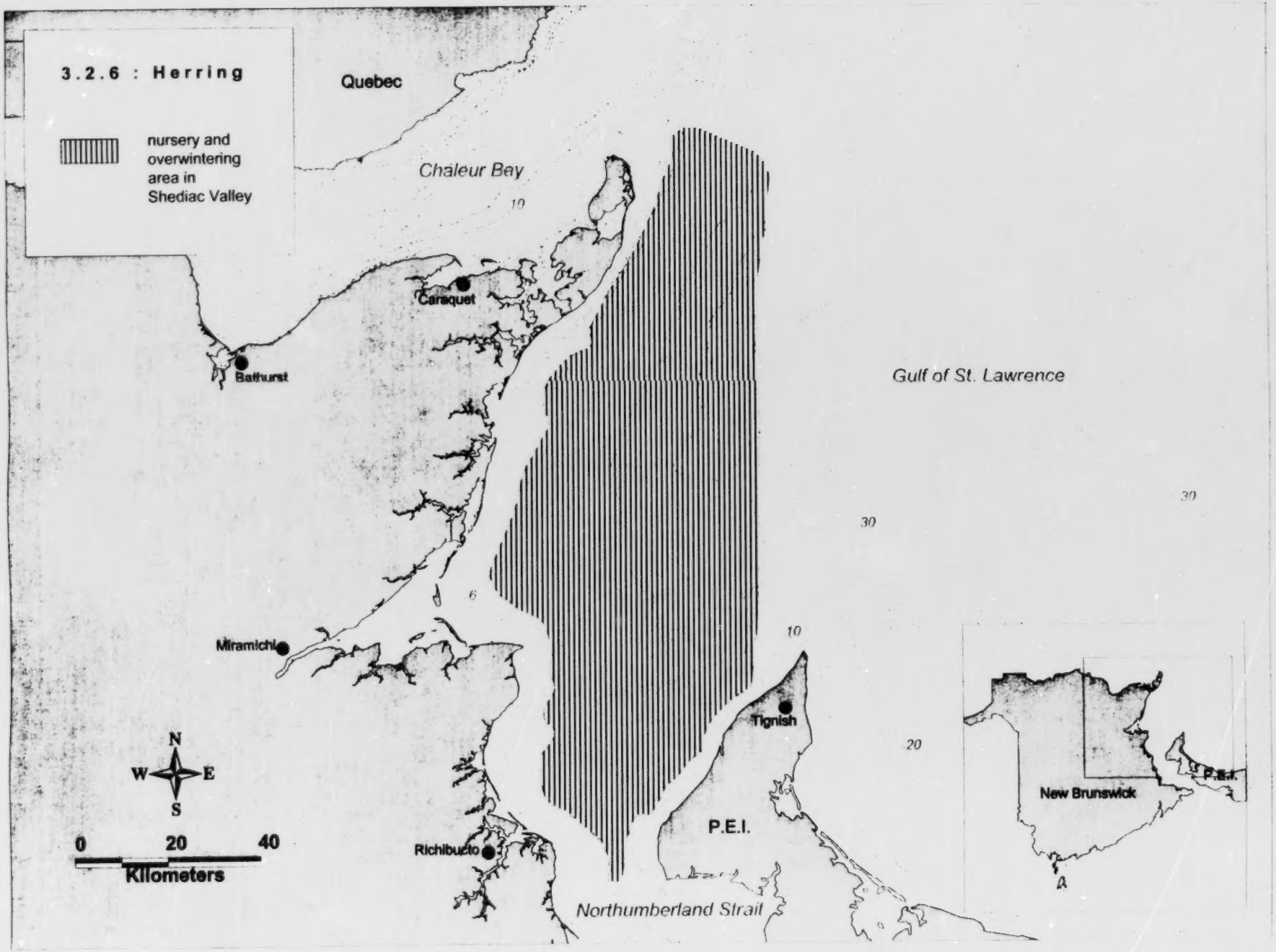
G14: Perley, 1852

G15: DFO (Herring), 1998

G16: DFO Statistics, 1998

G19: DFO Fishery officers, Shippagan, Tracadie-Sheila, Neguac, Baie St-Anne, Richibucto and PEI, p.c., 1999

G23: G. Chouinard, p.c., 1999


3.2.6 : Herring
nursery and overwintering area in Shediac Valley
Quebec
Chaleur Bay
10
Caraquet
Bathurst
Gulf of St. Lawrence
30
30
6
10
Miramichi
Tignish
20
N
W
E
S
0
20
40
Kilometers
Richibucto
P.E.I.
New Brunswick
P.E.I.
Northumberland Strait

3.2.7 Atlantic herring spawning ground in Miramichi and Escuminac

Ecological Features

- Herring spawning occurs at this site in both the spring and fall around Escuminac Point and in the Miramichi outer bay, east of the barrier islands[91,g19] (Figure 3.2.7). Fall spawning occurs between depths of 2 and 10 fathoms (3,2 to 16 m), while spring spawning occurs in depths less than 2 fathoms (3.2 m)[96].
- It is the second largest fall spawning habitat near the eastern N.B. coast, the largest one being on the Miscou Bank (3.2.5). It is the main spring spawning habitat, with the second largest one being at Cap Pelé[91] (3.2.9).
- This spawning ground slightly overlaps the nursery area in Shediac Valley (3.2.6), which is highly productive.
- Part of this spawning ground is located in Miramichi Bay, i.e. the portion of the estuary located directly upstream of the barrier islands. It is a highly productive region where numerous fish, crustaceans and molluscs are present in high concentrations.

Vulnerability, threats and human pressure

- The fall herring stock in Chaleur Bay is the most abundant[91,96] along the eastern coast of New Brunswick. The Miramichi and Escuminac spawning ground certainly contributes greatly to the fall spawning population since it is the second largest habitat for fall spawners.
- Spring spawning stocks near Escuminac are stable[91] and are the largest[96] stock along the eastern coast of New Brunswick. This spawning ground likely sustains the spring spawning population since it is the main habitat for spring spawners.
- The main sources of pollution on the Miramichi are mining activities (Heath Steele mine, located on a Northwest Miramichi tributary), pulp and paper mills (REPAP, Eagle, Acadia, Nelson Forest products) and wastewater from towns and villages[g25]. The problems associated with these pollutants are undetermined, but the suspected limiting factors include suspended sediments, sedimentation on the spawning ground and chemical pollution (metal, solvents, organic contaminants, etc.). Wastewater could have an impact on dissolved oxygen, due to increase in biochemical oxygen demand (BOD). REPAP has recently improved its water treatment facilities and complies with standards for dioxins and furans effluents since 1995, while suspended sediment criteria were met in 1997[g24].
- From 1920 to 1986, Domtar had a wood treatment facility in Newcastle; the waste was discharged into Chemical Creek, a tributary of the Miramichi [g26]. In 1984, sediment samples taken within a 100-meter radius of the main discharge channel were heavily contaminated with PAH, dioxins, and furans; a high

concentration of these substances was found in the lobster fished in Miramichi Bay in 1983 [926]. The site has since been cleaned [927].

- Most towns and villages now have water treatment facilities, but coliform levels remain high and have caused the closure of shellfish harvesting zones in the lower part of the estuary [926]. In 1998, a new collector was also built at the Strawberry Marsh treatment plant for the north side of the city of Miramichi. Similar projects are being planned in the short for the south side[924]. A few houses and cottages only have septic tanks and discharge insufficiently treated wastewater in the river and its tributaries [926].
- There are several former dumpsites in the Miramichi River basin that may be additional sources of pollution due to leaching.
- In 1981 and 1983, a navigation channel was dredged in the Miramichi (6.5×10^6 m^3 of sediments were dredged). The maintenance dredging of this channel is a potential source of habitat degradation. The increased turbidity of the water during dredging is a cause of concern, and the stability of the dumpsites has been questioned [918].
- There are three such sites: a relatively stable one in the estuary between Newcastle and Chatham, a second located outside of the barrier islands at the mouth of the Miramichi River and a third one, which is unstable, in the inner bay inside of the barrier islands [918].
- There are two major ports on the Miramichi River: Newcastle and Chatham. Ore used to be stored at these ports, and produced unknown amounts of pollution from runoff and percolation. This is no longer practised at these sites.
- There are a number of smaller fishing wharves in this area[917].
- The habitat may be affected by effluent from fish plants located in Escuminac. These effluents are characterised by high bacterial counts[917].
- Effluents from two commercial peat moss harvesting sites are draining directly into the spawning grounds[919].
- Two experimental herring roe fisheries ("Roe on Kelp") are conducted in the area. Two cages have been installed to capture herring roe[919].
- Harvesting of Irish moss also occurs (approximately 55 licenses in the area) on the spawning grounds, which may have an adverse impact since herring use the moss as a substrate on which to lay the eggs[919].

Socio-economic characteristics

- Herring is a commercially harvested species of high economic interest.
- Historically, the most profitable fisheries in the Gulf were herring, cod and mackerel[914].
- Herring landings increased in 1996 and 1997 in the Gulf of St. Lawrence as a whole[915].
- Commercially harvested species include: lobster in May and June (140), herring between April and June (300) and between August and October (100), flounder

in June (15 with fixed gear), Irish moss in June and July (18), mackerel between May and August (10 fishers with gill nets) and between July and September (100 anglers/days), rock crab in May and June and between August and October (4), smelt between October and February (25 commercial fishers) and between December and February (5 recreational fishers), clams between April and December (100 recreational fisher/days and 200 commercial fisher/days), oyster in October and November (300 on public beds) and between September and March (8 growers), mussel between January and December (25 recreational and 1 grower), surf clams between April and June and between September and December (150 recreational/days and 50 commercial harvesters) and quahog between April and December (25 recreational harvester/days)[919].

- 3500 inshore fishing licenses and 6 seining licenses are issued for herring in the Gulf[915].
- In eastern New Brunswick, total landings of herring reached 29 789 640 kg in 1998, with a commercial value of $4 812 194[916].

Support, favourable and unfavourable factors

- Local fishers may be in favour of more protection (specific status or management) [919].
- The Miramichi watershed is an Environment Canada "ACAP" site (Atlantic Canada Coastal Action Program), which means it is already benefitting from integrated management efforts. The *MREAC* (*Miramichi River Environmental Assessment Committee*) has been working to restore the ecological integrity of the ecosystem since 1989.

Other associated essential habitats

- Escuminac Point and Miramichi Bay are habitats of interest for the following species: striped bass (3.2.1), herring (Shediac valley, 3.26), lobster (3.3.3), oyster (3.4.2) and quahog (3.4.5), as well as blueback herring, eel, smelt, herring, gaspereau, sand lance, mackerel, smooth flounder, winter flounder, white hake, tomcod, surf clam, blue mussel, soft-shell clam, sea urchins, salmon and aquatic birds (see appendix).
- Atlantic herring is also associated with the following habitats of interest: western part of Chaleur Bay (3.2.3), New Mills (3.2.4), Miscou Bank (3.2.5), Shediac Valley (3.2.6), Richibucto (3.2.8), Cap Pelé (3.2.9) and Murray Beach (3.2.10), as well as Nepisiguit Bay, Caraquet, western shores of Lamèque and Miscou islands, Miramichi, Kouchibouguac, Richibucto, Bouctouche, Cocagne, Shediac Bay, Cape Tormentine and Baie Verte (see Appendix).

References

G1: C. LeBlanc, p.c., 1999

G6: Claytor et al., 1998

G11; Eaton and Gray, 1994

G14: Perley, 1852

G15: DFO(Herring), 1998

G16 : DFO Statistics, 1998

G17 : Hunter, 1975

G18 : Buckley, 1995

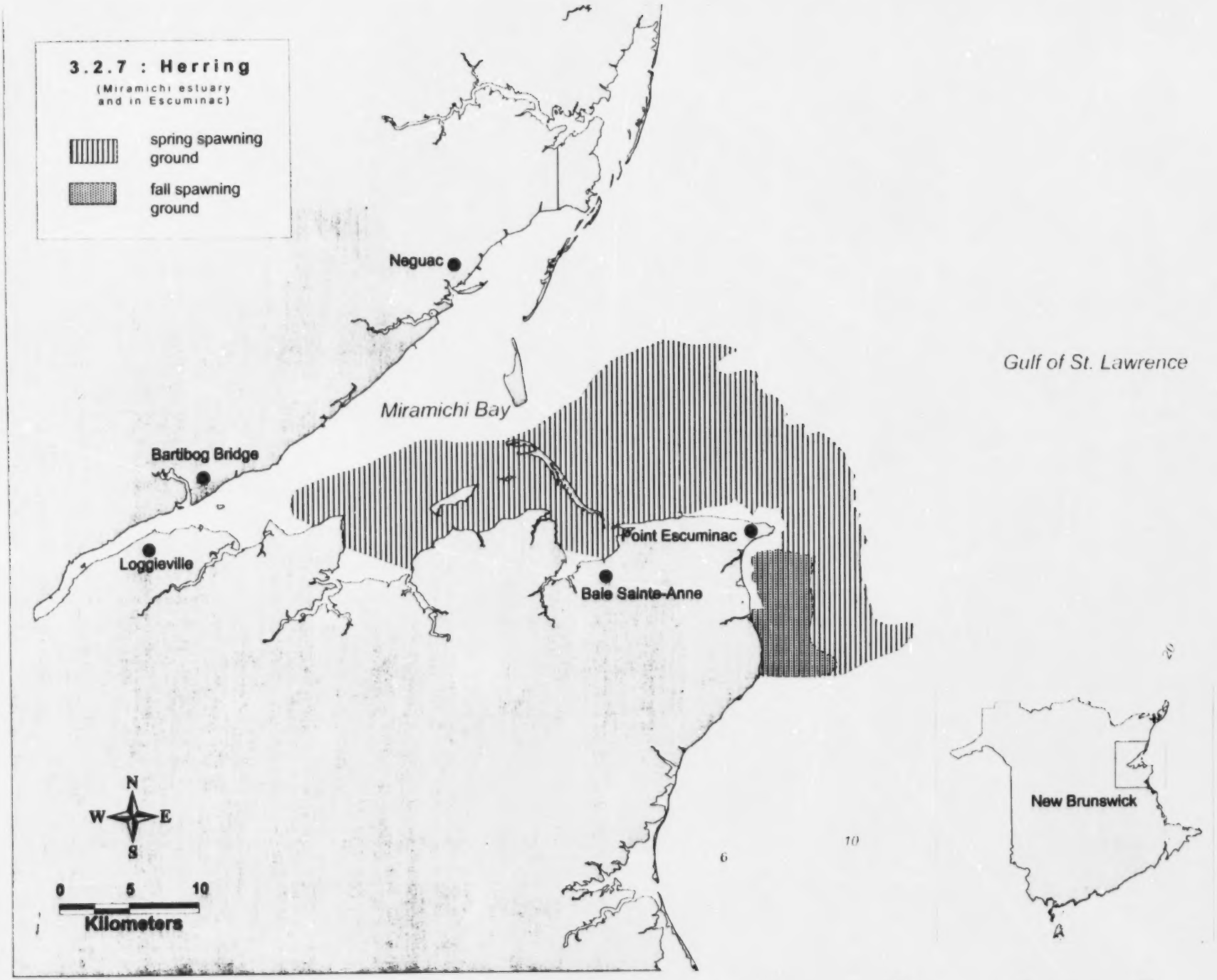
G19 : DFO Fishery officers, p.c., 1999

G24: H. Collins, p.c. 2000

G25: Buckley, 1995

G26: Eaton and Gray, 1994

G27: S. Courtenay, p.c.,1999


3.2.7 : Herring
(Miramichi estuary and in Escuminac)
spring spawning ground
fall spawning ground
Neguac
Miramichi Bay
Gulf of St. Lawrence
Bartibog Bridge
Loggieville
Point Escuminac
Baie Sainte-Anne
N
W
E
S
0
5
10
Kilometers
New Brunswick

3.2.8 Atlantic herring spawning ground in Richibucto

Ecological Features

- Spring spawning habitat near the point south of Richibucto (Figure 3.2.8). Spring spawning occurs at depths of less than 2 fathoms (3.2 m)[96].
- Less important spawning habitat, as the largest spawning habitats for spring spawners on the east coast of N.B. are located at Miramichi and Escuminac (3.2.7) and in Cap Pelé[91] (3.2.9).
- This habitat borders the current gyre located at the entrance to the Northumberland Strait[97], which is a highly productive area.

Vulnerability, threats and human pressure

- The Escuminac spring spawning stock, which is the largest near the northeastern coast of New Brunswick[96], is stable[91].
- Herring, crab, lobster and smelt are fished along the coast of the Northumberland Strait[919].
- There is harvesting of Irish moss between June and August in this area (10 to 15 licenses)[919].
- Fish processing plants located in Cap-Lumière produce high bacterial counts in the effluent[919].
- There are a number of fishing wharves in the area[917].

Socio-economic characteristics

- Herring is a commercially harvested species of high economic interest.
- Historically, the most profitable fisheries in the Gulf were herring, cod and mackerel[914].
- Herring landings increased in 1996 and 1997 in the Gulf of St. Lawrence as a whole[915].
- Commercially harvested species in this sector include: lobster between August and October (150 fishers), herring between April and June (50), Irish moss in June (12), mackerel in July and August (15 angler/days) and between May and August (6 fishers with fixed gear), and rock crab in May and June and between August and October (2) [919].
- 3500 inshore fishing licenses and 6 seining licenses have been issued for herring in the Gulf[915].
- In eastern New Brunswick, total landings of herring reached 29 789 640 kg in 1998, with a commercial value of $4 812 194[916].

Support, favourable and unfavourable factors

- Local herring and lobster fishers may be in favour of a change of status (protected area) or management plan[919].
- A sustainable development project has been under way since 1997 to restore the ecological integrity of the watershed.

Other associated essential habitats

- Richibucto Point is a habitat of interest for the following species: sea scallop (3.4.8), as well as surf clam (see appendix).
- Atlantic herring is also associated with the following habitats of interest: western part of Chaleur Bay (3.2.3), New Mills (3.2.4), Miscou Bank (3.2.5), Shediac Valley (3.2.6), Miramichi and Escuminac (3.2.7), Cap Pelé (3.2.9) and Murray Beach (3.2.10), as well as Nepisiguit Bay, Caraquet, western shores of Lamèque and Miscou islands, Miramichi, Kouchibouguac, Richibucto, Bouctouche, Cocagne, Shediac Bay, Cape Tormentine and Baie Verte (see Appendix).

References

G1: C. LeBlanc, p.c., 1999

G6: Claytor et al., 1998

G7: Lauzier, 1965

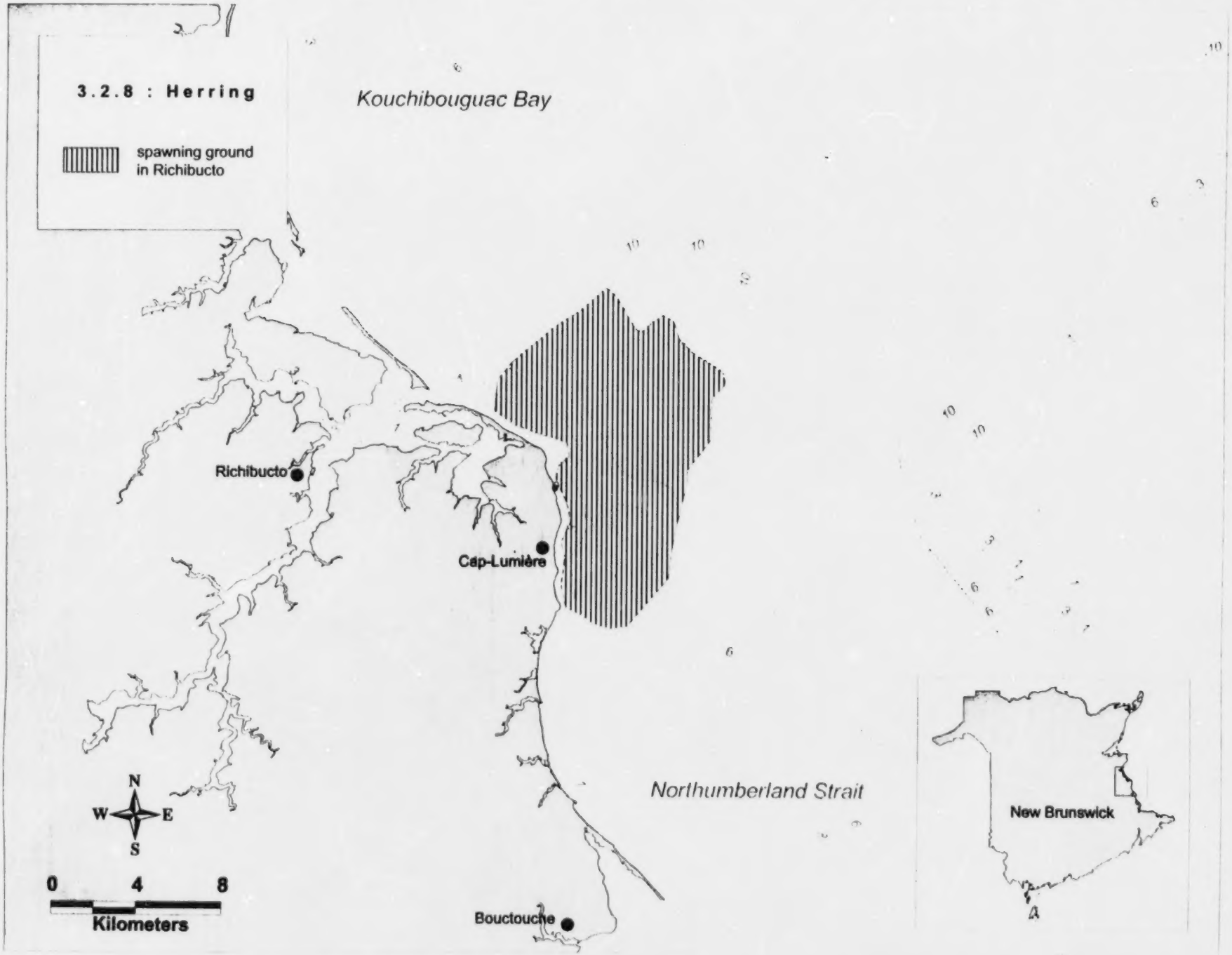
G14: Perley, 1852

G15: DFO (Herring), 1998

G16: DFO Statistics, 1998

G17: Hunter, 1975

G19: DFO Fishery officers, Richibucto, p.c., 1999


3.2.8 : Herring
spawning ground in Richibucto
Kouchibouguac Bay
Richibucto
Cap-Lumière
Bouctouche
Northumberland Strait
N
W
E
S
0
4
8
Kilometers
New Brunswick

3.2.9 Atlantic herring spawning ground in Cap-Pelé

Ecological Features

- Spring spawning habitat near the point at Cap-Pelé (Figure 3.2.9). Spring spawning usually occurs at depths of less than 2 fathoms (3.2 m)[96].
- It is the second largest spring spawning ground, the main ones being in Miramichi and Escuminac [91] (3.2.7).

Vulnerability, threats and human pressure

- The Escuminac spring spawning stock, which is the largest[96] off the east coast of N.B., is stable[91]. This is the second largest spawning ground and surely contributes substantially to herring production.
- There are numerous fishing wharves in the area[917].
- The habitat may be affected by effluent from fish plants located in Cap-Pelé. These effluents are characterised by a high bacterial concentration[917], which may mostly impact shellfish beds.
- Herring, crab, lobster and smelt fishing are conducted along the coast of the Northumberland Strait[919].
- There are about 20 herring smokehouses in this area.

Socio-economic characteristics

- Herring is a commercially harvested species of high economic interest.
- Historically, the most profitable fisheries in the Gulf were herring, cod and mackerel[914].
- Herring landings increased in 1996 and 1997 for the Gulf of St. Lawrence as a whole[915].
- Commercially harvested species include: lobster between August and October (80 fishers), herring between April and June (90), smelt between November and February (6 fishers), mackerel in August and September (100 angler/days) and between May and August (6 fishers with drift nets) and rock crab between May and July (3)[919].
- 3500 inshore fishing licenses and 6 seining licenses are issued for herring in the Gulf[915].
- In all of eastern New Brunswick, total landings of herring reached 29,789,640 kg in 1998, with a commercial value of $4 812 194[916].

Support, favourable and unfavourable factors

- Local herring fishers may be in favour of the protection of this area (special status or management) if it is in fact threatened[919].

Other associated essential habitats

- Cap-Pelé is a habitat of interest for the following species: rock crab and quahog (see appendix).
- Atlantic herring is also associated with the following habitats of interest: western part of Chaleur Bay (3.2.3), New Mills (3.2.4), Miscou Bank (3.2.5), Shediac Valley (3.2.6), Miramichi and Escuminac (3.2.7), Richibucto (3.2.8) and Murray Beach (3.2.10), as well as Nepisiguit Bay, Caraquet, western shores of Lamèque and Miscou islands, Miramichi, Kouchibouguac, Richibucto, Bouctouche, Cocagne, Shediac Bay, Cape Tormentine and Baie Verte (see Appendix).

References

G1: C. LeBlanc, p.c., 1999

G6: Claytor et al., 1998

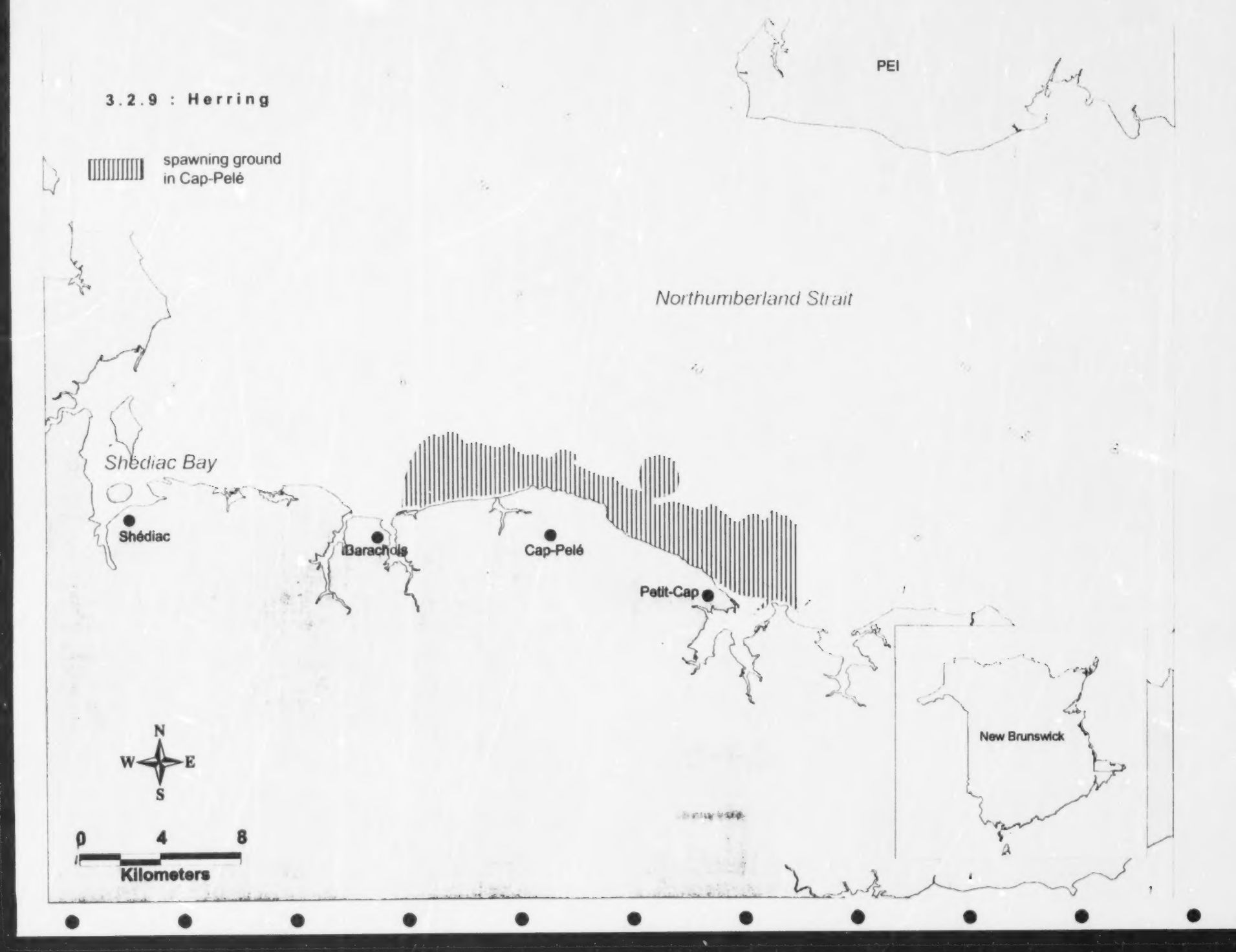
G14: Perley, 1852

G15: DFO (Herring), 1998

G16: DFO Statistics, 1998

G17: Hunter, 1975

G19: DFO Fishery officers, Shediac, p.c., 1999


3.2.9 : Herring
spawning ground in Cap-Pelé
PEI
Northumberland Strait
Shédiac Bay
Shédiac
Barachois
Cap-Pelé
Petit-Cap
New Brunswick
N
W
E
S
0
4
8
Kilometers

3.2.10 Atlantic herring spawning ground in Murray Beach

Ecological Features

- Spring herring spawning habitat off Murray Beach, between Shemogue and Cape Tormentine (Figure 3.2.10). It is a less important spring spawning ground, the main ones off the N.B. coast being in Miramichi, Escuminac (3.2.7) and in Cap Pelé[91] (3.2.9).

Vulnerability, threats and human pressure

- The Escuminac spring spawning stock, which is the largest off the eastern coast of New Brunswick[96], is stable[91].
- There are many fishing wharves in the area[917].
- Herring, crab, lobster and smelt fishing are carried out along the Northumberland Strait coast[919].

Socio-economic characteristics

- Herring is a commercially harvested species of high economic interest.
- Historically, the most profitable fisheries in the Gulf were herring, cod and mackerel[914].
- Herring landings increased in 1996 and 1997 for the Gulf of St. Lawrence as a whole[915].
- Commercially harvested species include: lobster between August and October (100 fishers), herring between April and June (60), mackerel in August and September (10 anglers), surf clams between April and June and between September and December (50) and rock crab between August and October (4)[919].
- 3500 inshore fishing licenses and 6 seining licenses have been issued for herring in the Gulf[915].
- In all of eastern New Brunswick, total landings of herring reached 29,789,640 kg in 1998, with a commercial value of $4,812,194[916].

Support, favourable and unfavourable factors

- Possibility of a partnership with the Canadian Wildlife Service, which has interests in the area.
- Good habitat for shorebirds and waterfowl during their migration.
- A natural park and a national wildlife reserve were established in nearby Cape Jourimain in 1996.

Other associated essential habitats

- The Murray Beach area is a habitat of interest for the following species: lobster (3.3.5), sea scallop (3.4.9), as well rock crab, surf clam and quahog (see appendix).
- Atlantic herring is also associated with the following habitats of interest: western part of Chaleur Bay (3.2.3), New Mills (3.2.4), Miscou Bank (3.2.5), Shediac Valley (3.2.6), Miramichi and Escuminac (3.2.7), Richibucto (3.2.8) and Cap-Pelé (3.2.9), as well as Nepisiguit Bay, Caraquet, western shores of Lamèque and Miscou islands, Miramichi, Kouchibouguac, Richibucto, Bouctouche, Cocagne, Shediac Bay, Cape Tormentine and Baie Verte (see Appendix).

References

G1: C. LeBlanc, p.c., 1999

G6: Claytor et al., 1998

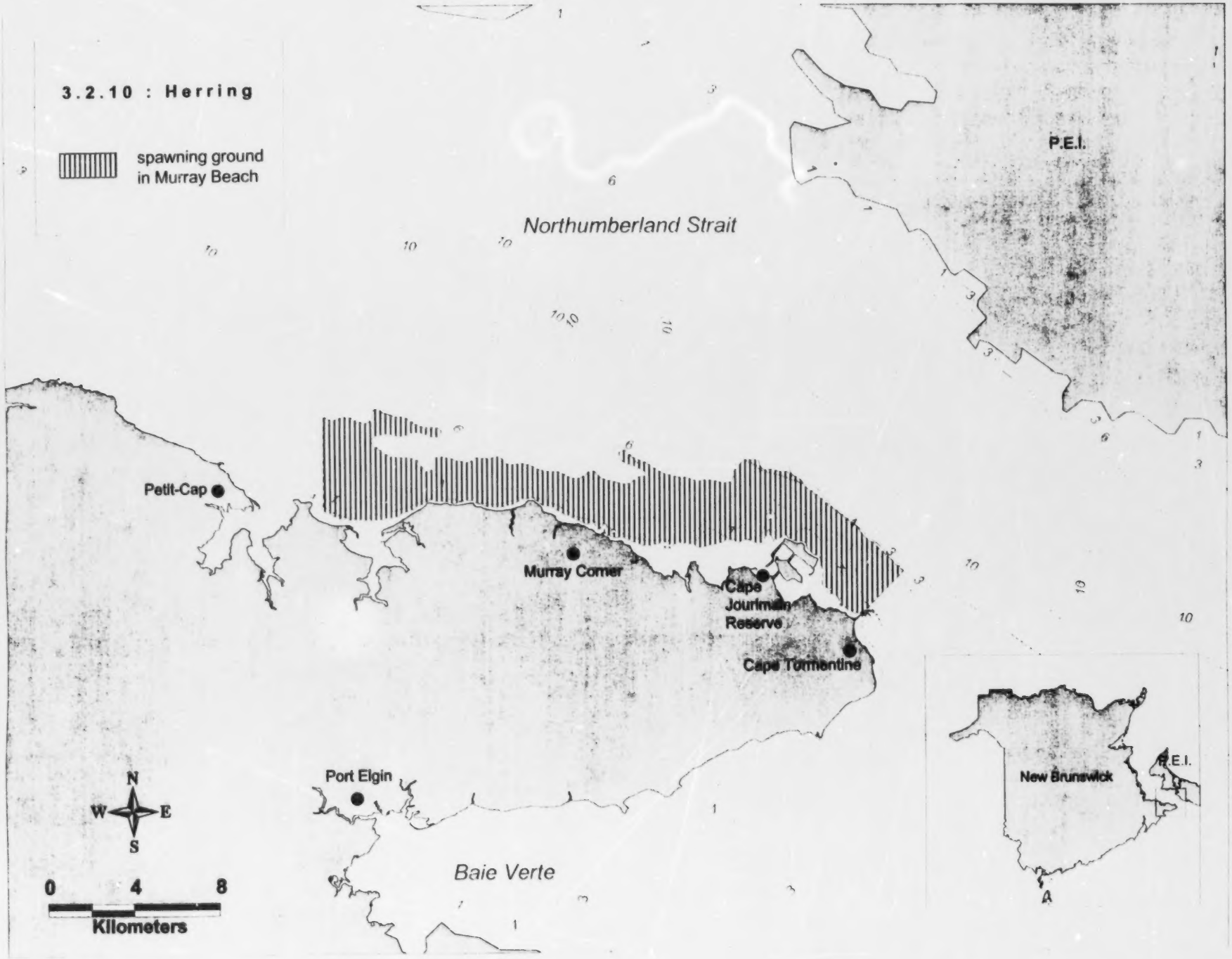
G14: Perley, 1852

G15: DFO (Herring), 1998

G16: DFO Statistics, 1998

G17: Hunter, 1975

G19: DFO Fishery officers, p.c., 1999


3.2.10 : Herring
spawning ground in Murray Beach
Northumberland Strait
P.E.I.
Petit-Cap
Murray Corner
Cape Jourimain Reserve
Cape Tormentine
Port Elgin
Baie Verte
N
W
E
S
0
4
8
Kilometers
New Brunswick
P.E.I.
A

3.2.11 Atlantic mackerel spawning ground on Bradelle and Orphan banks

Ecological Features

- Atlantic mackerel spawning grounds are found on Bradelle and Orphan banks[q1,q2] (Figure 3.2.11). The boundaries are approximate because the data comes from egg concentration assessment cruises with a relatively low spatial sampling density [q2].
- It is the main known mackerel spawning ground for the Canadian stock. Another important spawning ground is found in Chaleur Bay[q1], and probably another minor one in Cape Tormentine[q3] (see appendix).

Vulnerability, threats and human pressure

- Mackerel is sensitive to water temperature changes, resulting in sharp fluctuations in the concentration areas and in the catch rate[q2].
- Northwest Atlantic stocks are made up of two populations, one spawning in the Gulf, the other on the east coast of the United States. Because these two populations share the same overwintering areas on Georges Banks, the Gulf population is also affected by American fishing pressure [q2].
- The abundance of Atlantic herring and Atlantic mackerel are inversely proportional; when one species is abundant, the other is in decline[q5].
- After squid and herring, Atlantic mackerel is a major prey for bluefin tuna[q8].

Socio-economic characteristics

- Atlantic mackerel is a commercially harvested species of high economic interest.
- Atlantic mackerel landings have gradually decreased in the Gulf since the late 1980's[q2]. However, these fluctuations are related much more to mackerel distribution, fishing power and market demands than to real variations in abundance[q7].
- Historically, the mackerel fishery was among the most lucrative fisheries in eastern Canada [q6].
- Landings of macquerel in some provinces appear to be greatly underestimated since a large portion of the mackerel is not sold to processing plants and therefore does not show up in the official statistics[q7].
- Landings for macquerel in eastern New Brunswick peaked in 1988 at 4,399 mt, in 1998 they were at 1,533 mt. The commercial value of Atlantic mackerel in 1998 was $883,000[q7].
- Commercially harvested species in the area include: snow crab between April and June (81 fishers in New Brunswick, 2 in Nova Scotia, 30 in PEI and 47 in Quebec), herring in April and May (150 with fixed gear) and in September and

October (20 with mobile gear), mackerel in April and May (150 with fixed gear and 20 with mobile gear), and groundfish between May and August (10 with mobile gear) and between May and September (150 fishers with fixed gear)[q9].

Support, favourable and unfavourable factors

- A Laurentian Region DFO study has identified this site for protection because it is used by mackerel and cod for spawning. The same study referred to sand and silt bottoms habitats on Bradelle Bank, which contain snow crab concentrations[q10].

Other associated essential habitats

- The Bradelle and Orphan banks are habitats of interest for the following species: Atlantic herring (3.2.6) and Atlantic cod (3.2.13 and 3.2.14). They are also habitats of interest for other species but the information gathered deals primarily with New Brunswick inshore areas.
- Atlantic mackerel is also associated with the following habitats of interest: Shippagan Bay (3.2.12), as well as Chaleur Bay and Miramichi Bay (see appendix).

References

Q1: F. Grégoire, p.c., 1999

Q2: DFO (mackerel), 1997

Q3: MacNeil, J.L. & Assoc., 1998

Q5: White and Johns, 1997

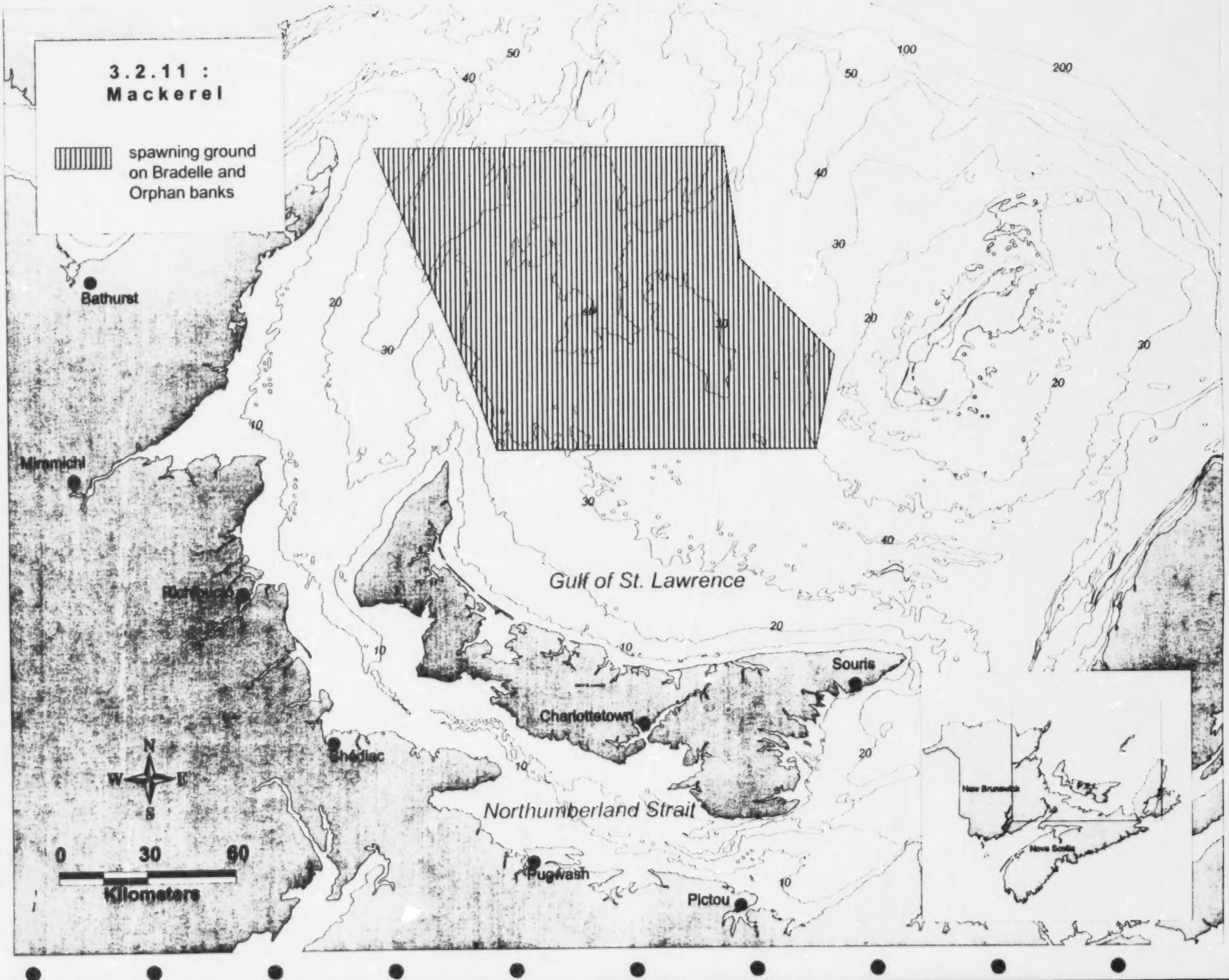
Q6: Perley, 1852

Q7: DFO Statistics, 1998

Q8: Clay and Hurlbut, 1988

Q9: Fishery officers, NB, PEI and Laurentian Region, p. c. 1999

Q10: Maurice Lamontagne Institute, DFO, 1998f.


3.2.11 :
Mackerel
spawning ground on Bradelle and Orphan banks
Bathurst
Miramichi
Richibucto
Shédiac
Charlottetown
Souris
Pictou
Pugwash
Gulf of St. Lawrence
Northumberland Strait
N
W
E
S
0
30
60
Kilometers
New Brunswick
PEI
Nova Scotia

3.2.12 Juvenile Atlantic mackerel concentration in Shippagan Bay

Ecological Features

- There is a concentration of juvenile Atlantic mackerel in Shippagan Bay [q1] (Figure 3.2.12). Boundaries are approximate and correspond to the principal channel of the bay, known for its high productivity because of rapid current exchanges at each tide due to the different water levels between Chaleur Bay and the Gulf of St. Lawrence [q4].
- Major known juvenile mackerel concentration, but other concentrations are likely along the shore where the juveniles tend to migrate [q1,q2].

Vulnerability, threats and human pressure

- Mackerel is sensitive to water temperatures. This causes sharp fluctuations in concentration areas and in catches [q2].
- Northwest Atlantic stocks are made up of two populations, one spawning in the Gulf, the other on the east coast of the United States. Because these two populations share the same overwintering areas on Georges Banks, the Gulf population is also affected by American fishing pressure [q2].
- The stability of the barrier islands extending from the southwestern entrance to Shippagan Bay is necessary as the narrowness of the gully they create affects tidal current velocities.
- The abundance of Atlantic herring and Atlantic mackerel are inversely proportional; when one species is abundant, the other is in decline[q5].
- After squid and herring, Atlantic mackerel is a major prey for bluefin tuna[q8].
- There is mussel farming in Shippagan bay [q9].
- There is lots of navigation in the bay [q9].
- The effluent outfall from the municipal sewage plant is also located in Shippagan Bay and the effluent is characterised by high bacterial concentrations[q9].
- Two peat moss operations on Lamèque Island cause turbidity and sedimentation problems. Their effluents flow into the bay [q9].
- Maintenance dredging of Shippagan channel is done regularly to maintain a waterway.

Socio-economic characteristics

- Atlantic mackerel is a commercially harvested species of high economic interest.
- Atlantic mackerel landings have gradually decreased in the Gulf since the late 1980's[q2]. However, these fluctuations are related much more to mackerel

distribution, fishing power and market demands than to real variations in abundance[q7].

- Historically, the mackerel fishery was among the most lucrative fisheries in eastern Canada [q6].
- Landings of macquerel in some provinces appear to be greatly underestimated since a large portion of the mackerel is not sold to processing plants and therefore does not show up in the official statistics[q7].
- Landings for macquerel in eastern New Brunswick peaked in 1988 at 4,399 mt, in 1998 they were at 1,533 mt. The commercial value of Atlantic mackerel in 1998 was $883,000[q7].
- Commercially harvested species in the area include: lobster in May and June (7 fishers), smelt between October and February (30 commercial fishers) and between December and February (100 recreational fishers), mussel between January and December (3 on private mussel beds), oysters between September and March (unknown number of fishers), and rock crab in May and June, and between August and October (3)[q9].

Support, favourable and unfavourable factors

Other associated essential habitats

- Shippagan Bay is a habitat of interest for the following species: lobster (3.3.1), as well as Atlantic mackerel (spawning ground in Chaleur Bay), winter flounder and blue mussel (see appendix).
- Atlantic mackerel is also associated with the following habitats of interest: Bradelle and Orphan banks (3.2.11), Chaleur Bay and Miramichi Bay (see appendix).

References

Q1: F. Grégoire, p.c., 1999

Q2: DFO (mackerel), 1997

Q4: D. Haché, p.c., 1999

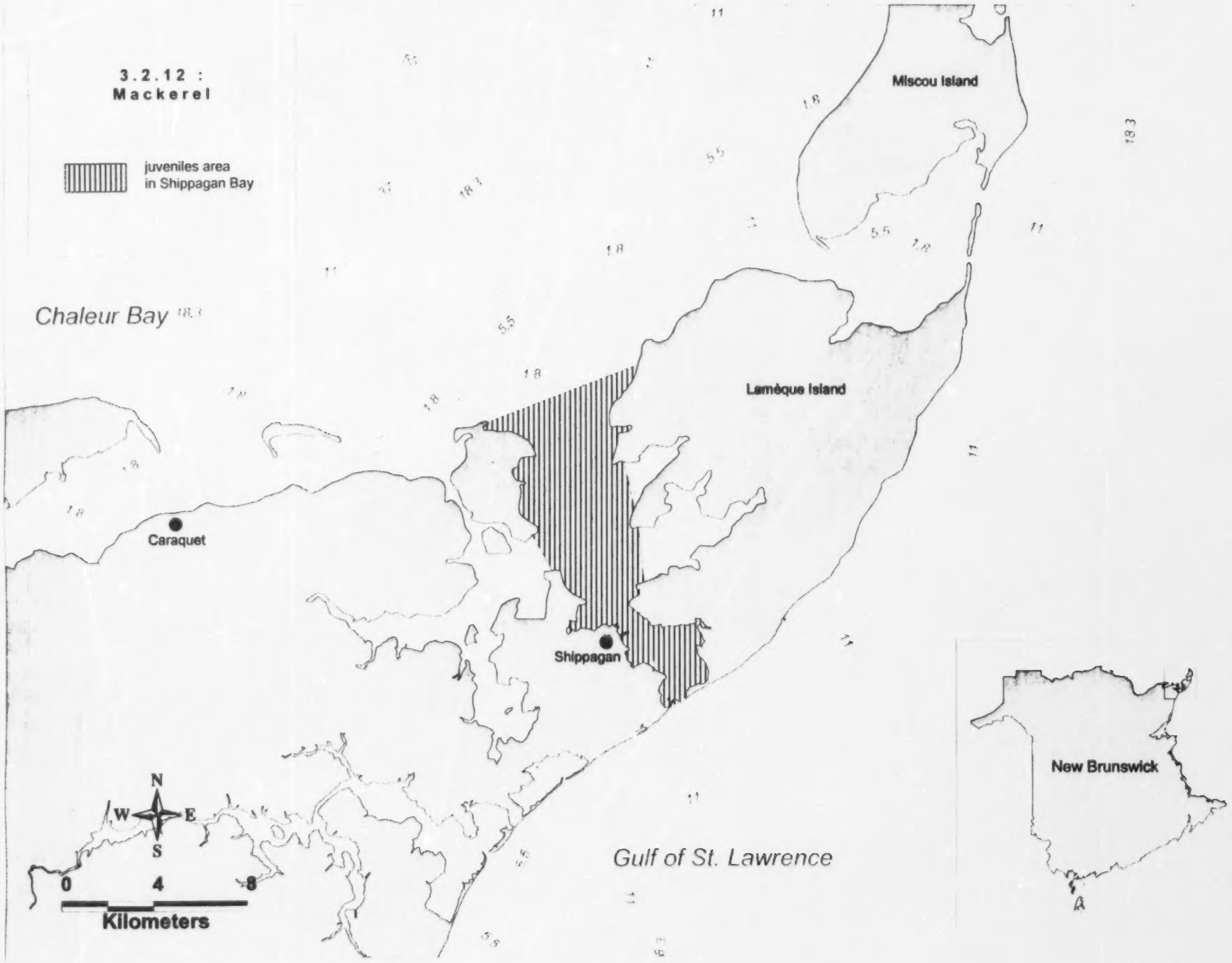
Q5: White and Johns, 1997

Q6: Perley, 1852

Q7: DFO Statistics, 1998

Q8: Clay and Hurlbut, 1988

Q9: Fishery officers, Shippagan, p.c., 1999


3.2.12 :
Mackerel
juveniles area
in Shippagan Bay
Miscou Island
Chaleur Bay
Lamèque Island
Caraquet
Shippagan
N
W
E
S
0
4
8
Kilometers
Gulf of St. Lawrence
New Brunswick

3.2.13 Juvenile Atlantic cod concentration in Shediac Valley

Ecological Features

- Concentration of juvenile Atlantic cod in Shediac Valley, according to inventory data [m1, m2, m3, m4, m5, m6, m7] (Figure 3.2.13). The area boundaries are approximate and are dependent on annual and seasonal variations in distribution, as well as sampled areas (e.g. shallower waters, less than 10 fathoms (16 m), were usually not sampled).
- Juveniles, generally less than 45 cm in length and aged 3 years and less (sexual maturity is reached between 3 and 7 years of age), are mostly concentrated in two areas: Shediac Valley and north of the Magdelen Islands [m1, m3, m5]. Juveniles are also found in Chaleur Bay [m2, m4, m5, m7, m8], but in lower concentrations and mixed in with a higher number of adults [m5]. Juveniles are usually found at depths of between 12.5 to 43.5 fathoms (20 m and 70 m)[m9], and less than 31 fathoms (50 m) for younger cohorts (< 3 years) [m4].
- Juvenile concentrations are higher in the southern part of the valley [m2, m4, m5, m6, m7, m8, m10], particularly for young less than 2 years old, especially around a current gyre at the entrance to Northumberland Strait [m11].
- Shediac Valley is a highly productive area, used as a nursery area for juvenile Atlantic herring (3.2.6).
- The proportion of the Atlantic cod biomass found in the southeastern part of the Gulf is greater than before [m14]. The abundance of the population, however, remains low [m1, m3, m14].

Vulnerability, threats and human pressure

- Considered as an endangered species, according to COSEWIC.
- The Shediac Valley nursery is the main nursery area off the eastern coast of New Brunswick [m5], with a second one located in Chaleur Bay[m5]. The other major area is located north of the Magdelen Islands [m3, m5].
- The stock was in sharp decline in the early 1990s. The closure of the fishery halted this decline and the stock has remained stable since 1993 [m3].
- Recruitment is low, as a result of an increased annual mortality rate due to unknown causes [m3]. The following factors, their synergy, or a still unknown cause may be at fault: environmental conditions (colder water temperatures, etc.), predation, unreported catches, modifications in the biological cycle of the species.
- Bottom trawling and dragging have a harmful effect on groundfish habitat by flattening the bottoms [m15], which could favour juvenile predation. Ice can have the same effect and on a larger scale.
- Harvesting or overfishing of species that are prey to other commercially exploited species can affect recruitment. Fishers and scientists worry that the

growth of the capelin fishery in the Gulf could hurt the recovery of the Atlantic cod stocks by eliminating one of its important food sources [m12].

Socio-economic characteristics

- Atlantic cod was a commercially harvested species of economic interest.
- Atlantic cod from the southern part of the Gulf has been fished since at least the 16th century[m13].
- Fishing was first practised with lines and fishhooks, until the end of the 1940's, when the ban on the use of trawls was lifted.
- Landings were very high until 1970 [m13].
- Stocks dropped until the mid-1970s and subsequently recovered until the mid-1980s [m13].
- In the 1980s, the use of fixed gear declined and mobile gear was used until the fishery was closed in September 1993 due to low stocks [m13].
- Fishers' opinions concerning Atlantic cod stocks vary: in the Gaspé Peninsula, fishers mostly believe stocks are low; in Nova Scotia and New Brunswick, they have seen a slight increase; in Prince Edward Island, fishers believe stocks are quite high [m13].
- Cod stock status reports in 1997 revealed that the stock continues to be low and shows little sign of recovery [m13]. However, in 1998, it was determined that the 1996 cohort would be larger, which is promising [m1].
- Species harvested in the area include lobster in May and June (310 fishers), and between August and October (132 fishers), scallop between June and October (162), mackerel between March and August (130 with drift nets, 110 with fixed gear), herring in April and May (20), and between July and October (30), groundfish between August and November (300 angler/days) and between April and December (15 with gill nets and 76 with fixed gear), as well as rock crab in May and June and between August and October (10)[m16].

Support, favourable and unfavourable factors

- Some cod fishers could favour a new management or protection status for this area.
- Capelin fishers (2 fishers, pilot study) may be opposed to a different management or protection status.
- Scallop fishers could also oppose changes in management or protection in the area.
- This site covers an area with multiple provincial jurisdictions.

Other associated essential habitats

- Shediac Valley is a habitat of interest for the following species: Atlantic herring (3.2.6, 3.2.7 and 3.2.8), Atlantic mackerel (3.2.11), lobster (3.3.3) and sea scallop (3.4.8) as well as winter flounder (see appendix).
- Atlantic cod is not associated with other habitats of interest near the east coast of New Brunswick. However, there is a relatively high abundance of juveniles in Chaleur Bay, and a high concentration of adults on Miscou Bank (see appendix).

References

M1: G. Chouinard, p.c., 1999

M2: Swain, 1999

M3: Sinclair et al., 1998

M4: Hanson, 1996

M5: Chouinard et al., 1991

M6: Chouinard et al., 1990

M7: Tremblay and Sinclair, 1985

M8: Chouinard and Sinclair, 1989

M9: Swain, 1993

M10: Swain and Poirier, 1997

M11: Lauzier, 1965

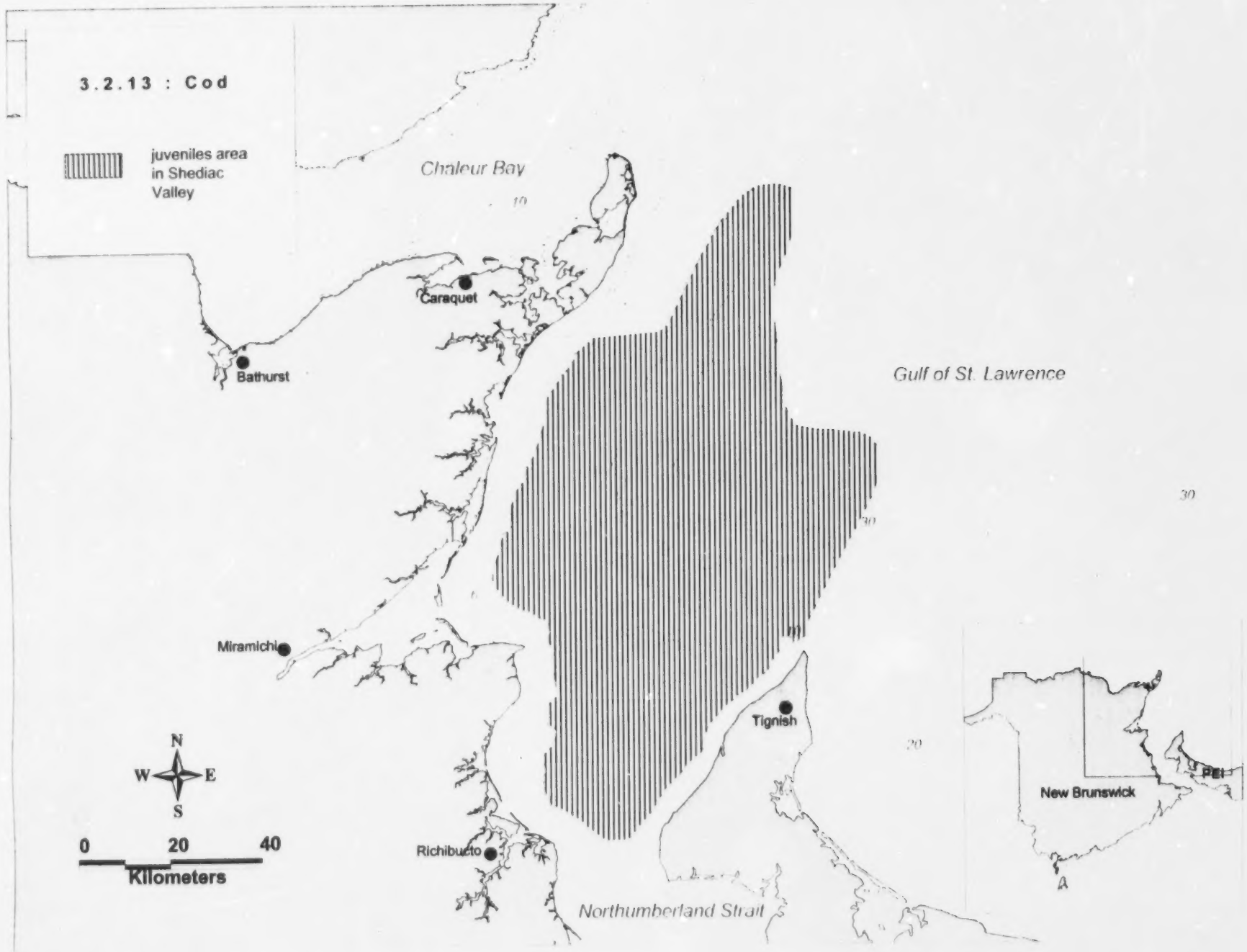
M12: White and Johns, 1997

M13: DFO (cod), 1998

M14: Chouinard at al., 1998 (ground fish)

M15: Watling and Norse, 1998

M16: DFO Fishery officers, Shippagan, Tracadie Sheila, Neguac, Baie St-Anne, Richibucto, PEI, p.c., 1999


3.2.13 : Cod
juveniles area in Shediac Valley
Chaleur Bay
Caraquet
Bathurst
Gulf of St. Lawrence
Miramichi
Tignish
Richibucto
Northumberland Strait
New Brunswick
PEI
N
W
E
S
0
20
40
Kilometers

3.2.14 Adult cod high concentration on Miscou Bank

Ecological Features

- Sentinel fisheries and scientific surveys[m1, m2] (Figure 3.2.14) revealed high concentrations of adult cod on the Miscou Bank. The area boundaries are approximate and adult concentrations can also be found in other areas such as Chaleur Bay, but probably in smaller concentrations. There is also some temporal variability and concentrations can fluctuate.
- This is the largest known concentration of adult cod along the northeastern coast of New Brunswick. Another concentration covering a smaller area was observed near the mouth of Miramichi Bay[m2].
- Miscou Bank is a highly productive area, and is used as a nursery area for a number of species, as indicated by the relatively high landings, known spawning grounds (herring) and intense fishing effort which characterize the area. However, exploitation may also reflect a productive habitat less easily accessible by larger trawlers, and therefore of greater interest to inshore fishers.
- The proportion of the Atlantic cod biomass found in the southeastern part of the Gulf is larger than before [m14]. The abundance of the population, however, remains low [m1, m3, m14].
- Known spawning site for a number of species.
- Migration route for whales, which also use it as a feeding ground.

Vulnerability, threats and human pressure

- The stock fell sharply in the early 1990s. The closure of the fishery halted this decline and the stock has remained stable since 1993 [m3].
- Recruitment is low, as a result of an increased annual mortality rate due to unknown causes [m3]. The following factors, their synergy, or a still unknown cause may be at fault: environmental conditions (colder water temperatures, etc.), predation, unreported catches, modifications in the biological cycle of the species.
- Bottom trawling and dragging have a harmful effect on groundfish habitat by flattening the bottoms [m15], which could favour juvenile predation. Ice can have the same effect and on a larger scale.
- Harvesting or overfishing of species that are prey to other commercially exploited species can affect recruitment. Fishers and scientists worry that the growth of the capelin fishery in the Gulf could hurt the recovery of the Atlantic cod stocks by eliminating one of its important food sources [m12].
- Whale watching tours and boat cruises from Miscou Island are human factors to be taken into account[m18].

Socio-economic characteristics

- Atlantic cod was a commercially harvested species of high economic interest until the fishery closure in 1993[m13].
- Atlantic cod from the southern Gulf has been fished since at least the 16th century [m13].
- Fishing was first practised with lines and fishhooks, until the end of the 1940's, when the ban on the use of trawls was lifted.
- Landings were very high until 1970 [m13].
- Stocks dropped until the mid-1970s and subsequently recovered until the mid-1980s [m13].
- In the 1980s, the use of fixed gear declined and mobile gear was used until the fishery was closed in September 1993 due to low stocks [m13].
- Fishers' opinions concerning Atlantic cod stocks vary: in the Gaspé Peninsula, fishers mostly believe stocks are low; in Nova Scotia and New Brunswick, they have seen a slight increase; in Prince Edward Island, fishers believe stocks are quite high [m13].
- Cod stock status reports in 1997 revealed that the stock continues to be low and shows little sign of recovery [m13]. However, in 1998, it was determined that the 1996 cohort would be larger, which is promising [m1]
- Species harvested in the area include lobster in May and June (8 fishers), herring between August and October (575 fishers with fixed gear, 20 with mobile gear), capelin in June (2), mackerel between June and August (5000 angler/days) and between May and September (100 with drift nets), groundfish in June (5 with mobile gear), between August and December (160 fishers with fixed gear) and between August and November (500 angler/days), halibut between June and August (10 fishers) and flounder between April and December (150 fishers with fixed gear)[m16].

Support, favourable and unfavourable factors

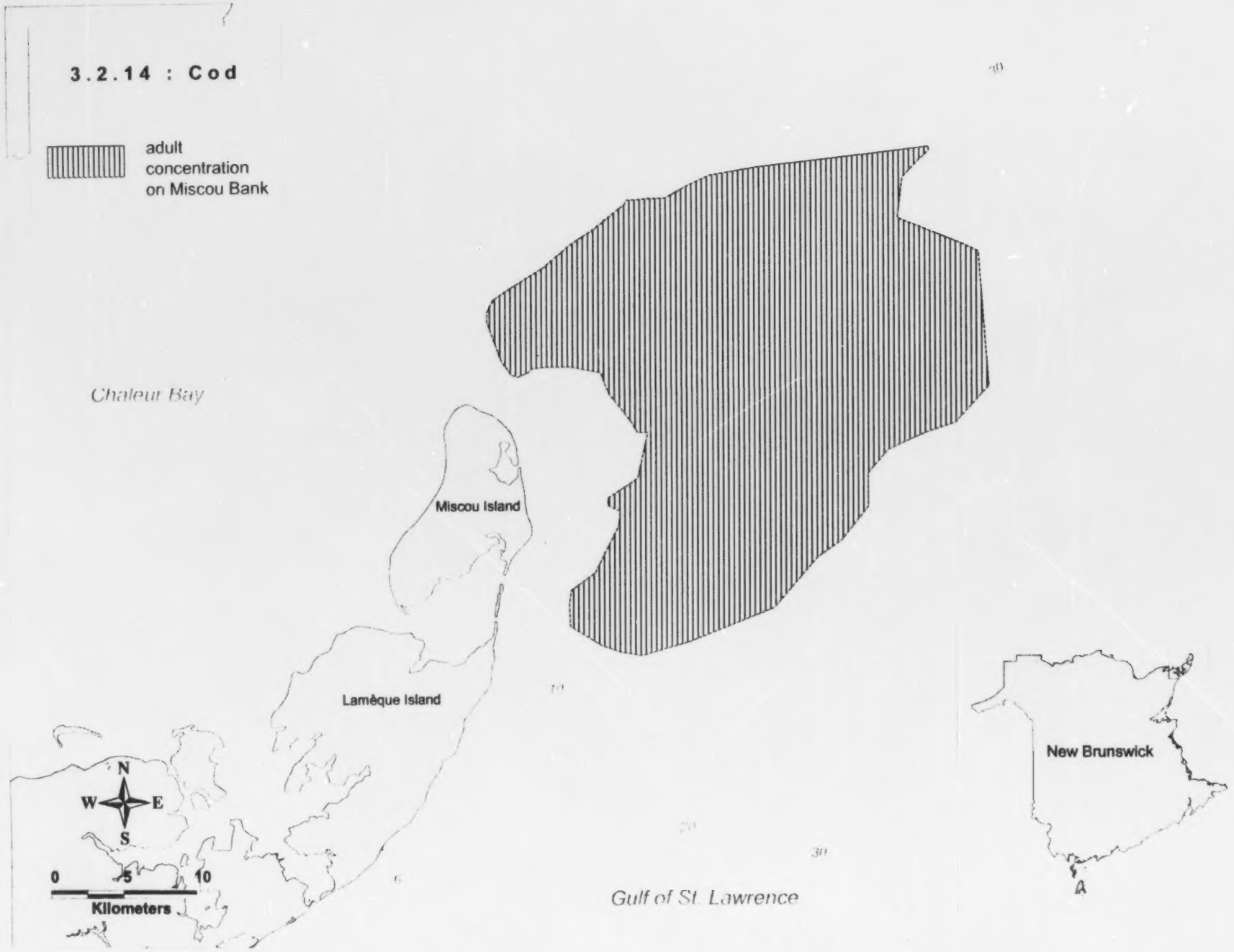
- Some cod fishers could favour a new management or protection status for this area.
- Capelin fishers (2 fishers, pilot study) may be opposed to a different management or protection status.
- Scallop fishers could also oppose changes in management or protection in the area
- The Canadian Wildlife Service has recognised the importance of this habitat as a potential protection site, as does the "Important Bird Area" program, because of the number of marine birds feeding in the area.

Other associated essential habitats

- Miscou Bank is an habitat of interest for the following species: capelin (3.2.2), Atlantic herring (3.2.5 and 3.2.6), Atlantic mackerel (3.2.11), Stimpson's surf clam (3.4.4), deep sea scallop (3.4.7), as well as halibut, gray seal, mackerel, cod and deep sea scallop (see appendix).
- Cod is also associated with other habitats of interest: juvenile concentration in Shediac Valley (3.2.13), as well as relatively high abundance of juveniles in Chaleur Bay (Appendix).

References

M1: G. Chouinard, p.c., 1999
M2: Swain, 1999
M3: Sinclair et al., 1998
M12: White and Johns, 1997
M13: DFO (cod), 1998
M14: Chouinard at al., 1998 (ground fish)
M15: Watling and Norse, 1998
M16: DFO Fishery officers, Shippagan and Laurentian Region, p.c., 1999
M17: Hunter, 1975
M18: Department of Economic Development and Tourism, 1998


3.2.14 : Cod
adult concentration on Miscou Bank
Chaleur Bay
Miscou Island
Lamèque Island
N
W
E
S
0
5
10
Kilometers
Gulf of St. Lawrence
New Brunswick

3.2.15 White hake spawning ground in Baie Verte

Ecological Features

- Spawning and nursery habitat for white hake in Baie Verte[b1] (Figure 3.2.15). Habitat boundaries are not well defined and are based on information provided by fishers[b2]. The spawning ground was well populated until the early 1980s, when there was a sharp drop in stocks. Brief, but intensive harvesting took place, as it was known to be a spawning site[b1].
- This habitat borders the current gyre at the southern entrance to the Northumberland Strait.
- According to data gathered in 1999, white hake abundance (all ages combined) has slightly increased, but remains lower than the historic average, which is a cause of worry. The higher landings were due to catches of relatively small (20 cm –35 cm) fish[b5].
- There is little information about the biology of white hake in the Gulf of St. Lawrence, especially in spawning and nursery areas[b6]. [b6] There is anecdotal evidence (reported by scientists and fishers) [b6] of spawning in eelgrass beds, which are then used as nursery areas by juveniles. Young of the year are found at depths of about one meter[b6]. Adult hake seems to prefer water temperatures between 5 and 11°C and soft bottoms. Hake migrates with cod in the winter, in the deeper waters of the 4Vn area.
- A huge eelgrass bed is found in the upstream portion of the southern part of Baie Verte. At low tides, the inside of the bay appears to be green, hence its name, which means "green bay" in French. This bed was virtually wiped out by disease or climatic changes[b9] in the early 30s, but has recovered since the 1950s.
- Spawning usually occurs in June[b4].

Vulnerability, threats and human pressure

- Abundance of the overall Hake stock in the southern Gulf of St. Lawrence fell sharply in the early 1990s. The closure of the fishery stopped the decline but the stock remains low[b3].
- The natural mortality rate remains high, but the causes are unknown[b3]. Groundfish trawling in the 1980s and scallop dragging, which is still practised, may be detrimental to this habitat.
- Considerable by-catches of white hake occur during groundfish fisheries, especially those targeting cod, winter flounder, redfish and halibut.
- The geographical distribution of the species is relatively narrow. Hake is less abundant in the western part of the southern Gulf and the proportion of large-sized hake is smaller [b3]. Distribution is concentrated in a small portion of the area occupied by the stock prior to the 1990s. Main concentration areas are

St. George's bay and the Cape Breton Basin. It is considered scarce in other parts of the Gulf[b5]. This narrow distribution appeared to have been observed earlier in the case of Baie Verte, but the territory cannot be surveyed because of shallow depths and large number of lobster cages in the area during the survey period, in September.

Socio-economic characteristics

- There is local economic interest in the species, which was fished commercially until the closure in 1995[b4]. The Baie Verte hake population had collapsed before the fishery had closed, in the mid 1980s.
- Species harvested in the area include: lobster between August and October (125 fishers), herring in May and June (80), scallop between June and September (174), mackerel in July and August (30 anglers), and between May and August (5 commercial fishers), flounder between April and December (12 with fixed gear, 4 with mobile gear), rock crab in May and June and between August and October (16), surf clam between April and June and between September and December (1000 recreational harvester/days and 40 commercial harvesters) and soft-shell clam (15 recreational harvesters)[b7].

Support, favourable and unfavourable factors

- A number of fishers expressed concern about white hake stocks as early as the 1980s. Baie Verte fishers would be in favour of any action that would contribute to stock recovery.
- This site covers an area with multiple provincial jurisdictions.

Other associated essential habitats

- Baie Verte is a habitat of interest for the following species: American lobster (3.3.5), scallop (3.4.9), as well as herring, Atlantic mackerel, surf clam, rock crab and gray seal (see appendix).
- White hake is not associated with other habitats of interest.

References

B1: G. Chouinard, p.c., 1999

B2: MacNeil, J.L. & Assoc. 1998

B3: Hurlbut et al., 1998

B4: DFO (white hake), 1998

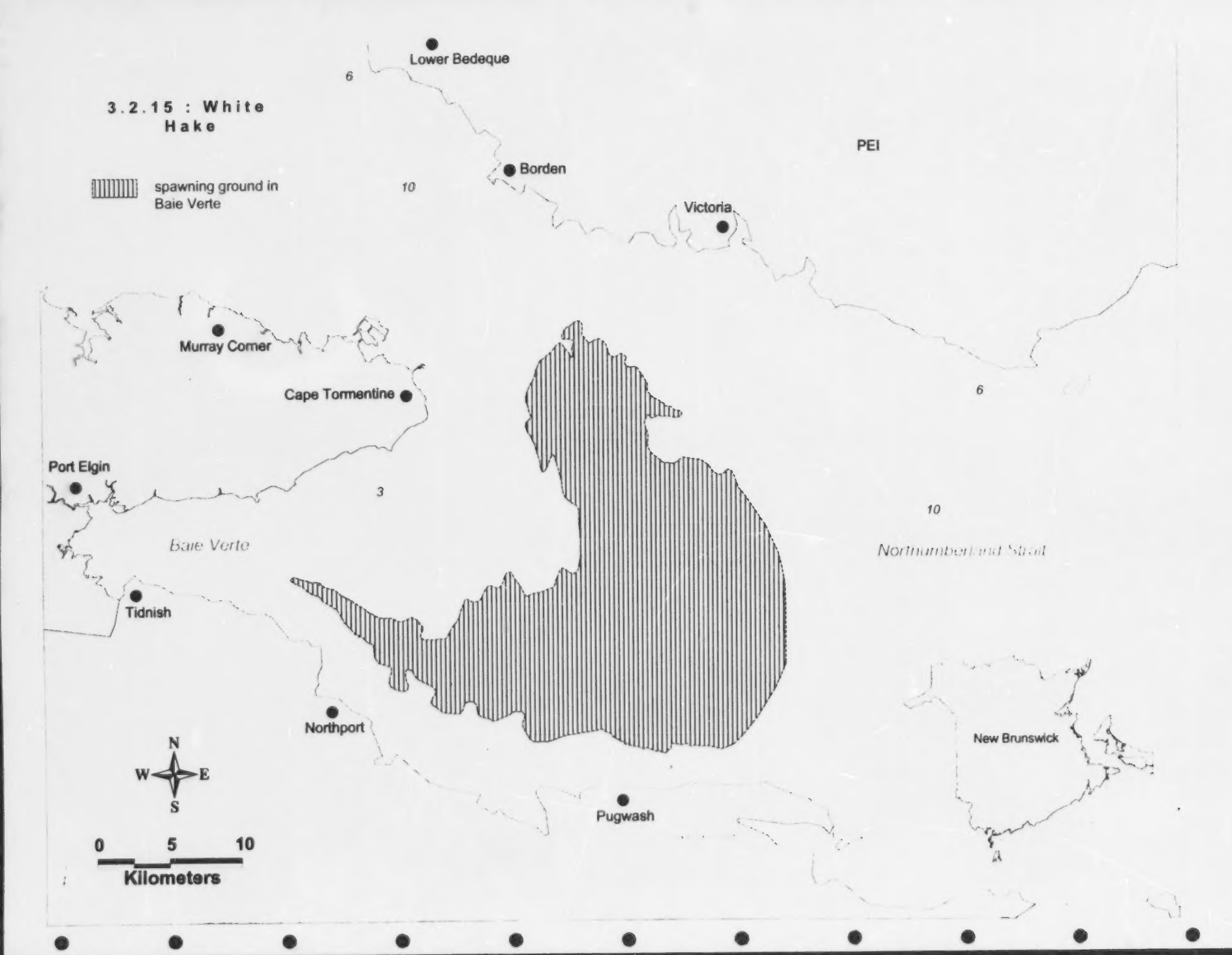
B5: DFO (groundfish in the Gulf of St. Lawrence), 2000

B6: T. Hurlbut p.c. 2000

B7: DFO Fishery officers, Shediac and PEI, p.c. 1999

B8: Rasmussen, 1977

B9: W. Landsburg, p.c. 1999


3.2.15 : White Hake
spawning ground in Baie Verte
Lower Bedeque
Borden
Victoria
PEI
Murray Corner
Cape Tormentine
Port Elgin
Baie Verte
Tidnish
Northport
Pugwash
New Brunswick
Northumberland Strait
6
10
3
N
W
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S
0 5 10
Kilometers

3.3.1 Large-sized American lobster and berried female concentration in the Caraquet, Shippagan, Lameque and Miscou areas (Chaleur Bay)

Ecological Features

- Concentration of large-sized American lobster and berried females in Caraquet Bay, extending outside to Lamèque Island and the upper portion of Shippagan Bay (Figure 3.3.1).
- Principal habitat of berried female lobsters in Chaleur Bay, west of Caraquet[h1] and one of the two habitats known for their high concentrations of large sized lobster[h2]. The other one is near Cape Tormentine. There is also a high concentration of berried females in Miramichi Bay[h2]. Adult lobster are present everywhere in Chaleur Bay, at depths varying from 0,5 to 25 fathoms (1 to 40 m)[h3, h4].
- Caraquet Bay is an extremely productive area, notably for American oyster, due to a sandbar that helps maintain higher water temperatures than in the rest of Chaleur Bay[h6]. Shippagan Bay is also a very productive area because of rapid current exchanges at each tide due to the different water levels between Chaleur Bay and the Gulf of St. Lawrence [h7].

Vulnerability, threats and human pressure

- The stability of the sandbar in Caraquet Bay could be jeopardized by erosion [h6].
- The stability of the barrier islands extending from the southwestern entrance to Shippagan Bay is necessary as the narrowness of the gully they create affects tidal current velocities.
- Overexploitation of recruits and shortage of egg production [h3].
- Catches in the southern Gulf are slowly dropping since the records reached in 1990. In 1997, landings had fallen by 25% compared to 1990 [h15].
- In 1995, the FRCC concluded that lobster fishing was currently conducted at high exploitation rates, on immature lobsters, and did not allow adequate egg production [h16].
- Measures taken to protect this resource have helped to improve the situation, i.e. adding a biodegradable panel (1993) and a rectangular escape mechanism for sub-legal size lobsters (1995).
- There is no intensive scallop fishing in the area, so it does not affect the epibenthic habitat at this time[h1]. Dragging of rough bottoms can have a serious adverse impact on lobster, with the proportion of captured and injured specimens reaching up to 12% [h8, h9].
- There are three major fishing wharves (Caraquet, Bas-Caraquet and Petit-Shippagan) in this area and several smaller ones [h11].
- Caraquet Bay is polluted by agricultural runoff, by municipal effluent outfalls, by fish plants, by effluent from a textile plant, by peat moss harvesting and by

fishing wharves; due to these various sources of pollution, oyster beds in the bay had to be closed on a number of occasions (fecal contamination)[h11].

- Since 1993, the Caraquet Sustainable Development Group has taken a number of corrective actions to restore the ecological integrity of the bay. Cottage septic tank systems and the municipal wastewater collection system were improved, which allowed the re-opening of shellfish harvesting areas. An 80% gain in this sector was observed. At the urging of the group, peat harvesters installed sedimentation ponds that reduced the amount of suspended sediment from peat harvesting.
- Tourism activities in Caraquet Bay include boat tours and mollusc harvesting [h13].
- Large lobsters get caught in the meshes during gill net fishing (herring)[h19].
- There is lobster poaching in this sector [h19].
- Scallop and groundfish dragging have an impact on large lobster (by-catch)[h19].
- Herring seining in the area during September and October, when lobster are migrating towards offshore areas, may have impacts of unknown amplitude[h19].
- There is trawling for winter flounder in the area. Winter flounder and lobster often share common habitats, so trawling for flounder in the fall, when lobsters migrate, will result in by-catches.
- Channel dredging occurs near Caraquet, Shippagan and Lamèque.
- Mussel farming in the area may have a positive impact on lobster.

Socio-economic characteristics

- American lobster is a commercially harvested species of high economic interest. It is the most important inshore fishery in the southern Gulf of St. Lawrence.
- Early in the century, there were large quantities of lobster in Chaleur Bay. It was used mostly as fertilizer on agricultural fields. In Shippagan and Caraquet, wagons were used to collect lobster caught in small depressions in the nearshore zone at low tide[h14].
- Over the years lobster fishing became, and remains, an important factor in the social and economic development of Atlantic coastal communities and in particular those of the Gulf of St. Lawrence [h15].
- One of the problems perceived in the lobster fishing industry is the shared responsibility between two government levels: fishing (licenses, management) is under federal jurisdiction, while lobster processing plants come under provincial responsibility. The lack of collaboration between these two regulatory bodies can indirectly have negative consequences on the fishing effort or on the fishers by creating economic expectations that do not match the stock status.
- Other commercially harvested species in the area include: lobster in May and June (90), herring between August and October (150), scallop between May and September (12), groundfish between August and November (70 recreational fisher/days), rock crab in May and June and between August and October (6), mackerel in July and August (140 angler/days), surf clam between April and

June and between September and December (300), mussel between January and December (3 on private mussel beds), soft-shell clam between April and December (500), oyster between September and March (private beds, unknown number) and in October and November (150 on public beds) and smelt between October and February (25)[h19].

Support, favourable and unfavourable factors

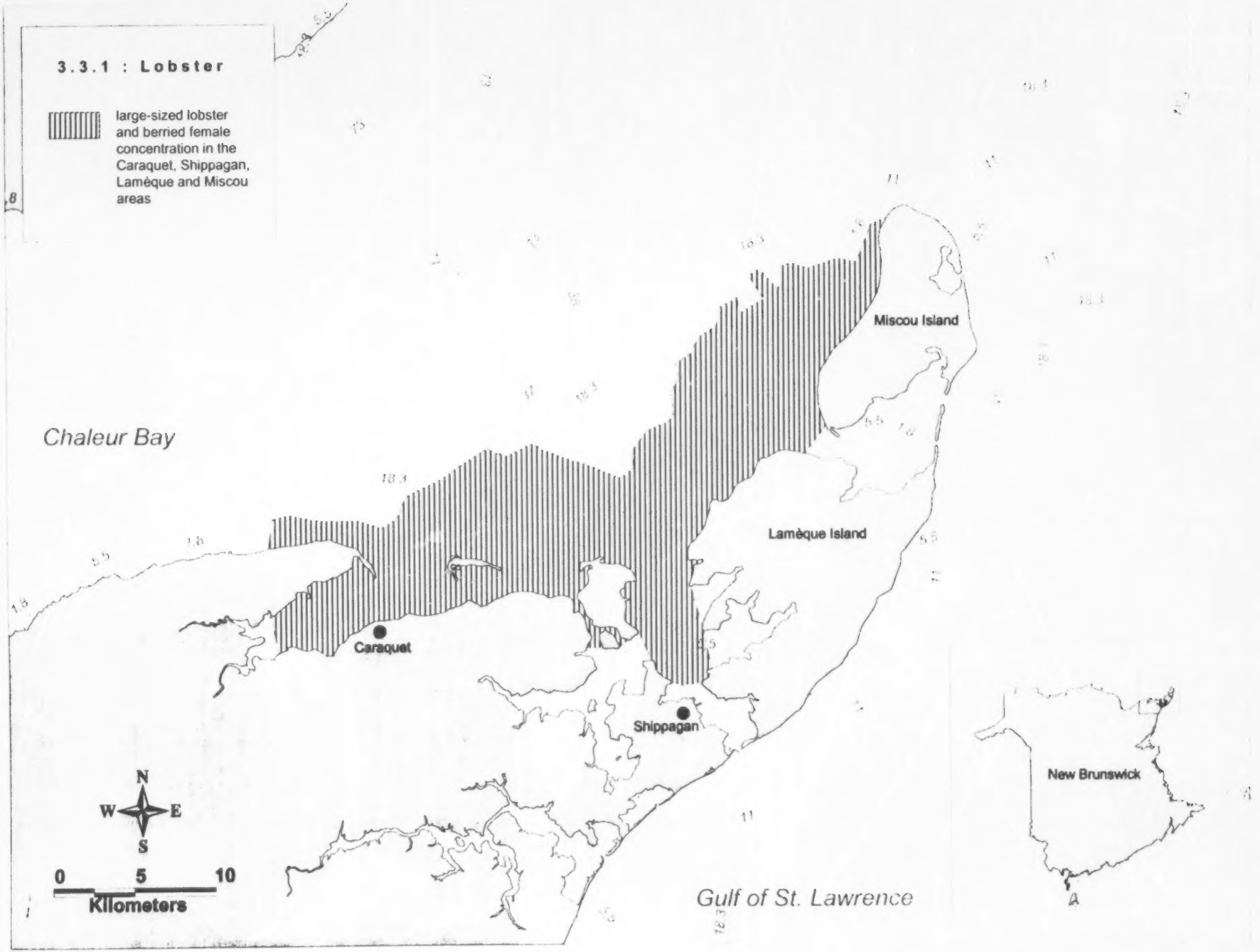
- Since 1995, Caraquet Bay has been the focus of integrated management efforts by the New Brunswick Department of Fisheries and Aquaculture to restore the ecological integrity of the bay.
- The protection of certain inshore habitats can contribute to maintaining the diversity of ecosystems and the geographical particularities of lobster populations. Maintaining and protecting these biological features could be the basis of a sustainable development of the lobster industry. This approach has the support of fishers in certain southern Gulf of St. Lawrence communities.
- Lobster fishers would probably be in favour of protection for this area (special status or management)[h9].
- Scallop and groundfish fishers may not be in favour of changes in management or protection status[h9].
- FRCC recommendations support any effort to protect lobster recruitment[h2].

Other associated essential habitats

- The Caraquet region is a habitat of interest for the following species: Atlantic mackerel (3.2.12), American oyster (3.4.1) and Atlantic herring, Atlantic mackerel, surf clam and aquatic birds (see appendix).
- Lobster is associated with the following habitats of interest: Tracadie (3.3.2), Miramichi and Escuminac (3.3.3), Kouchibouguac (3.3.4) and Cape Tormentine (3.3.5).

References

H1: MacNeil, J.L. & Assoc., 1998
H2: M. Lanteigne, p.c., 1999
H3: Lanteigne et al., 1998
H4: Lalumière et al., 1994
H5: E. Ferguson, p.c., 1999
H6: T. Landry, p.c., 1999
H7: D. Haché, p.c., 1999
H8: Jamieson et al., 1981
H9: Scarrat, 1975
H11: Hunter, 1975
H12: Eaton and Gray, 1994
H13: Department of Tourism and Economic Development, 1998
H14: Perley, 1852
H15: DFO (lobster), 1998
H16: FRCC, 1995
H17: DFO Statistics, 1998
H19: DFO Fishery officers, Caraquet, p.c., 1999


3.3.1 : Lobster
large-sized lobster and berried female concentration in the Caraquet, Shippagan, Lamèque and Miscou areas
Miscou Island
Chaleur Bay
Lamèque Island
Caraquet
Shippagan
New Brunswick
N
W
E
S
0
5
10
Kilometers
Gulf of St. Lawrence

3.3.2 Juvenile American lobster in the Tracadie area

Ecological Features

- Habitat with high concentrations of juvenile American lobster (pre-recruits) located about 3 km from the coast, off Tracadie (Figure 3.3.2). Boundaries are approximate and probably extend closer to shore.
- One of the two main known habitats of juvenile lobster concentrations, the other being at Kouchibouguac [h2].

Vulnerability, threats and human pressure

- Overexploitation of recruits and shortage of egg production [h3].
- Catches in the southern Gulf are slowly dropping since the records reached in 1990. In 1997, landings had fallen by 25% compared to 1990 [h15].
- In 1995, the FRCC concluded that lobster fishing was currently conducted at high exploitation rates, on immature lobsters, and did not allow adequate egg production [h16].
- Measures taken to protect this resource have helped to improve the situation, i.e. adding a biodegradable panel (1993) and a rectangular escape mechanism for sub-legal size lobsters (1995).
- There is no intensive scallop fishing in the area, as scallop dragging is done further offshore, so it does not affect the epibenthic habitat at this time[h1]. Dragging of rough bottoms can have a serious adverse impact on lobster, the proportion of captured and injured specimens reaching up to 12% [h8, h9]
- There are many tourist activities and beaches in the area [h13].

Socio-economic characteristics

- American lobster is a commercially harvested species of high economic interest. It is the most important inshore fishery in the southern Gulf of St. Lawrence.
- Over the years lobster fishing became, and remains, an important factor in the social and economic development of Atlantic coastal communities and in particular those of the Gulf of St. Lawrence [h15].
- One of the problems perceived in the lobster fishing industry is the shared responsibility between two government levels: fishing (licenses, management) is under federal jurisdiction, while lobster processing plants come under provincial responsibility. The lack of collaboration between these two regulatory bodies can indirectly have negative consequences on the fishing effort or on the fishers by creating economic expectations that do not match the stock status.
- Other commercially harvested species in this area include: lobster in May and June (30 fishers) and herring in April and May (10 fishers)[h19].

Support, favourable and unfavourable factors

- The protection of certain inshore habitats can contribute to maintaining the diversity of ecosystems and the geographical particularities of lobster populations. Maintaining and protecting these biological features could be the basis of a sustainable development of the lobster industry. This approach has the support of fishers in certain southern Gulf of St. Lawrence communities.
- FRCC recommendations support any effort to protect lobster recruitment[h2].

Other associated essential habitats

- This habitat is of interest for the following species: berried female lobster (see appendix).
- Lobster is associated with the following habitats of interest: Caraquet, Shippagan, Lameque and Miscou (3.3.1), Miramichi and Escuminac (3.3.3), Kouchibougouac (3.3.4) and Cape Tormentine (3.3.5).

References

H1: MacNeil, J.L. & Assoc., 1998

H2: M. Lanteigne, p.c., 1999

H3: Lanteigne et al., 1998

H8: Jamieson et al., 1981

H9: Scarrat, 1975

H11: Hunter, 1975

H13: Department of Tourism and Economic Development, 1998

H15: DFO (lobster), 1998

H16: FRCC, 1995

H17: DFO Statistics, 1998

H19: DFO Fishery officers. Tracadie-Sheila, p.c. 1999

3.3.2 : Lobster
juveniles area in the Tracadie region
Shippagan
Pokemouche
Tracadie-Sheila
Val-Comeau
Gulf of St Lawrence
New Brunswick
N
W
E
S
0
3.5
7
Kilometers

3.3.3 Ripe female American lobster in Miramichi and Escuminac

Ecological Features

- Site with high concentration of berried female lobster located in the Miramichi River estuary, inside and outside the barrier islands (outside limit is approximate), as well as around Point Escuminac[h1,h2,h19] (Figure 3.3.3). Adults are generally found in commercial concentrations at up to 20 fathoms (32m)[h3], but can live in deeper water, up to 140 fathoms (225 m) bordering the Scotian Shelf[h20].
- Principal habitat for berried females [h2], although other habitats are known [h1] (appendix).
- The highest concentration of berried females is found on this site between early August and the end of September [h19].

Vulnerability, threats and human pressure

- Overexploitation of recruits and shortage of egg production [h3].
- Catches in the southern Gulf are slowly dropping since the records reached in 1990. In 1997, landings had fallen by 25% compared to 1990 [h15].
- In 1995, the FRCC concluded that lobster fishing was currently conducted at high exploitation rates, on immature lobsters, and did not allow adequate egg production [h16].
- Measures taken to protect this resource have helped to improve the situation, i.e. adding a biodegradable panel (1993) and a rectangular escape mechanism for sub-legal size lobsters (1995).
- Maintenance of appropriate bottoms for this species could be jeopardized because scallop is fished in a substantial portion of the area, outside the barrier islands [h1]. Bottom dragging can harm lobster, with the proportion of captured and injured specimens reaching up to 12% [h8, h9].
- The major sources of pollution on the Miramichi are mining activities (Heath Steele mine, located on a Northwest Miramichi tributary), pulp and paper mills (REPAP, Eagle, Acadia, Nelson Forest products) and wastewater from towns and villages [b19]. The problems associated with these pollutants are undetermined, but the suspected limiting factors include suspended sediments, sedimentation on the spawning ground and chemical pollution (metal, solvents, organic contaminants, etc.). Wastewater could have an impact on dissolved oxygen (increase in BOD, or biochemical oxygen demand). REPAP has recently improved its water treatment facility and dioxins and furans effluents meet the guidelines since 1995, while suspended sediment criteria were met in 1997[h21].
- There are several former dumpsites in the Miramichi River basin that may be additional sources of pollution due to leaching.

- In 1981 and 1983, a navigation channel was dredged in the Miramichi (6.5×10^6 m^3 of sediments were dredged). The maintenance dredging of this channel is a potential source of habitat degradation. The increased turbidity of the water during dredging is a cause of concern, and the stability of the dumpsites has been questioned [h18].
- There are three such sites: a relatively stable one in the estuary between Newcastle and Chatham, a second located outside of the barrier islands at the mouth of the Miramichi River and a third one, which is unstable, in the inner bay inside of the barrier islands [h18].
- There are two major ports on the Miramichi River: Newcastle and Chatham [h11]. Ore used to be stored at these ports, and produced unknown amounts of pollution from runoff and percolation. This is no longer practised at these sites[h21].
- There are two peat bogs whose effluents flow into this area[h19].
- Oyster and Irish moss harvesting could harm the lobster [h19].

Socio-economic characteristics

- American lobster is a commercially harvested species of high economic interest. It is the most important inshore fishery in the southern Gulf of St. Lawrence.
- Over the years lobster fishing became, and remains, an important factor in the social and economic development of Atlantic coastal communities and in particular those of the Gulf of St. Lawrence [h15].
- One of the problems perceived in the lobster fishing industry is the shared responsibility between two government levels: fishing (licenses, management) is under federal jurisdiction, while lobster processing plants come under provincial responsibility. The lack of collaboration between these two regulatory bodies can indirectly have negative consequences on the fishing effort or on the fishers by creating economic expectations that do not match the resource status.
- Commercially harvested species include: lobster in May and June (200 fishers), and between August and October (60), scallop between June and September (12), mackerel between May and August (40 commercial fishers) and July to August (330 angler/days), herring between April and May (300 angler/days) and between July and September (130), smelt between November and February (70), gaspereau in May and June (2), eel between January and December (20 commercial fishers and 100 recreational fishers), oyster in June and July (18, re-lay fishing), between September and March (38 on private beds) and in October to November (450 on public beds), clams between April and December (220 commercial harvesters and 1100 recreational harvester/days), mussel between April and December (3 on private beds and 25 on public beds), flounder in June (15), Irish moss in June and July (1), rock crab in May and June and between August and October (10), surf clam between April and June

and between September and December (150 recreational harvester/days and 50 commercial) and quahog between April and December (25)[h19].

Support, favourable and unfavourable factors

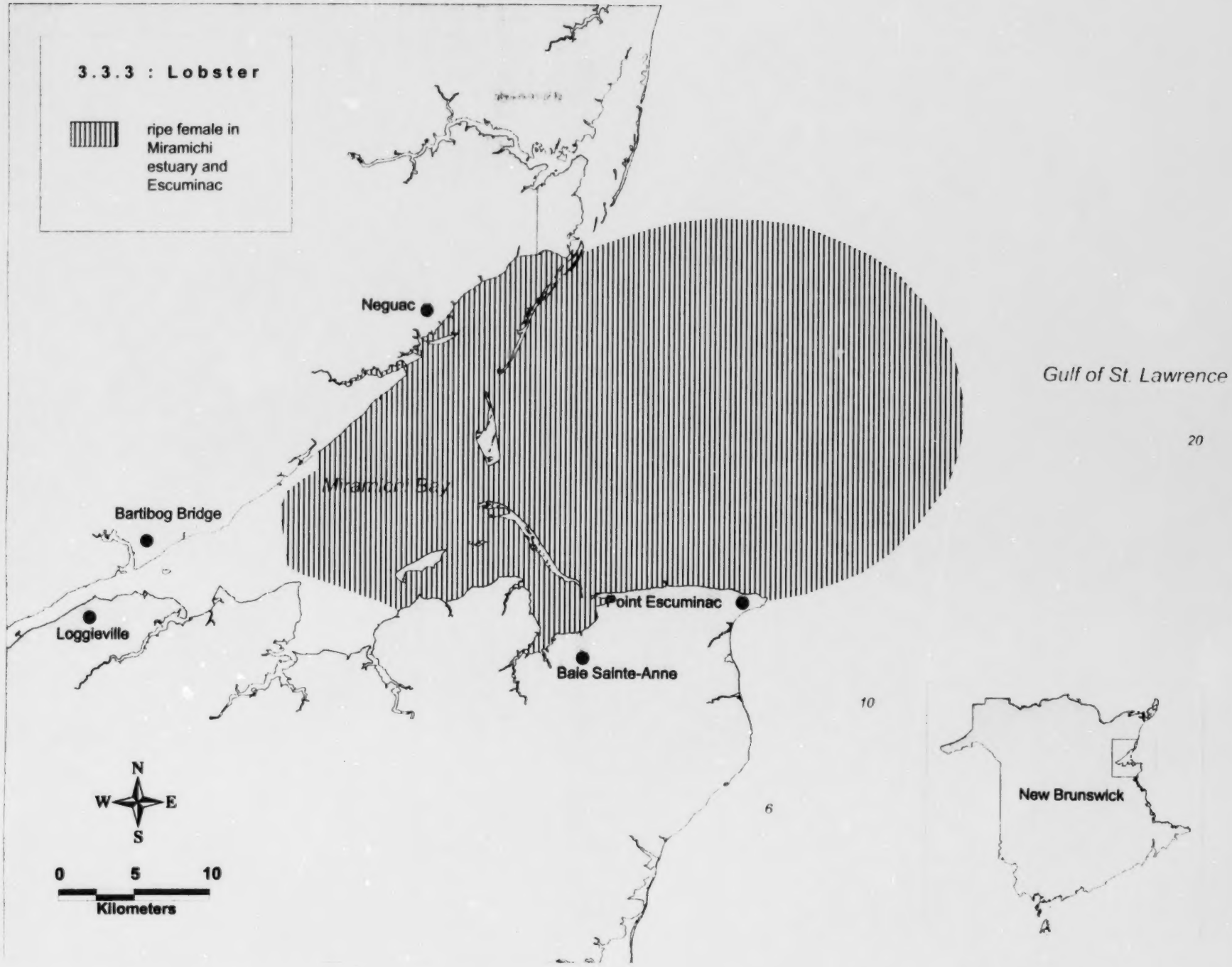
- The protection of certain inshore habitats can contribute to maintaining the diversity of ecosystems and the geographical particularities of lobster populations. Maintaining and protecting these biological features could be the basis of a sustainable development of the lobster industry. This approach has the support of fishers in certain southern Gulf of St. Lawrence communities.
- FRCC recommendations support any effort to protect lobster recruitment[h2].
- The Miramichi watershed is an Environment Canada "ACAP" site (Atlantic Canada Coastal Action Program), which means it is already benefitting from integrated management efforts. The *MREAC* (*Miramichi River Environmental Assessment Committee*) has been working to restore the ecological integrity of the ecosystem since 1989.

Other associated essential habitats

- This habitat is of interest for the following species: striped bass (3.2.1) herring (3.2.6 and 3.2.7), Atlantic cod (3.2.13), American oyster (3.4.2), sea scallop (3.4.8) and quahog (3.4.5), as well as blueback herring, American shad, American eel, smelt, gaspereau, sand lance, Atlantic mackerel, white hake, smooth flounder, winter flounder, Atlantic tomcod, surf clam, blue mussel, soft-shell clam, sea urchin, aquatic birds and salmon (see appendix).
- Lobster is associated with the following habitats of interest: Caraquet, Shippagan, Lameque and Miscou (3.3.1), Tracadie (3.3.2), Kouchibougouac (3.3.4) and Cape Tormentine (3.3.5).

References

H1: MacNeil, J.L. & Assoc., 1998
H2: M. Lanteigne, p.c., 1999
H3: Lanteigne et al., 1998
H8: Jamieson et al., 1981
H9: Scarrat, 1975
H11 : Hunter, 1975
H12: Eaton and Gray, 1994
H13: Department of Tourism and Economic Development, 1998
H14: Perley, 1852
H15: DFO (lobster), 1998
H16: FRCC, 1995
H17: DFO Statistics, 1998
H18: Buckley, 1995
H19: DFO Fishery officers, Néguac and Baie Ste-Anne, p.c., 1999
H20: FRCC, 1995
H21: H. Collins, p.c., 1999
H22: S. Courtenay, p.c., 1999


3.3.3 : Lobster
ripe female in Miramichi estuary and Escuminac
Neguac
Gulf of St. Lawrence
20
Miramichi Bay
Bartibog Bridge
Point Escuminac
Loggieville
Baie Sainte-Anne
10
6
New Brunswick
N
W
E
S
0
5
10
Kilometers

3.3.4 Juvenile American lobster in Kouchibouguac National Park area

Ecological Features

- Site of high concentrations of juvenile American lobster (pre-recruits) located about 3 km from the coast, off Kouchibouguac National Park (Figure 3.3.4). Boundaries are approximate and could extend closer to shore.
- One of the two main habitats with high juvenile lobster concentration, the other being in Tracadie [h2].

Vulnerability, threats and human pressure

- Overexploitation of recruits and shortage of egg production [h3].
- Catches in the southern Gulf are slowly dropping since the records reached in 1990. In 1997, landings had fallen by 25% compared to 1990 [h15].
- In 1995, the FRCC concluded that lobster fishing was currently conducted at high exploitation rates, on immature lobsters, and did not allow adequate egg production [h16].
- Measures taken to protect this resource have helped to improve the situation, i.e. adding a biodegradable panel (1993) and a rectangular escape mechanism for sub-legal size lobsters (1995).
- Maintenance of appropriate bottom may be jeopardized by scallop fishing and Irish moss harvesting in this sector [h19]. Dragging rough bottoms can have a serious adverse impact on lobster, with the proportion of captured and injured specimens reaching up to 12% [h8, h9].

Socio-economic characteristics

- American lobster is a commercially harvested species of high economic interest. It is the most important inshore fishery in the southern Gulf of St. Lawrence.
- Over the years lobster fishing became, and remains, an important factor in the social and economic development of Atlantic coastal communities and in particular those of the Gulf of St. Lawrence [h15].
- One of the problems perceived in the lobster fishing industry is the shared responsibility between two government levels: fishing (licenses, management) is under federal jurisdiction, while lobster processing plants come under provincial responsibility. The lack of collaboration between these two regulatory bodies can indirectly have negative consequences on the fishing effort or on the fishers by creating economic expectations that do not match the stock status.
- Species harvested in this habitat include lobster between August and October (12 fishers) and herring in April and May (4)[h19].

Support, favourable and unfavourable factors

- Kouchibouguac National Park presently protects the land and marine resources adjacent to the proposed habitat. Enhanced protection of the marine environment would assist Park authorities in their protection efforts. Presently, these efforts focus on conservation of the common tern colony, gray and harbour seal haulouts, as well as piping plovers, red-breasted merganser and a variety of other aquatic birds.
- The protection of certain inshore habitats can contribute to maintaining the diversity of ecosystems and the geographical particularities of lobster populations. Maintaining and protecting these biological features could be the basis of a sustainable development of the lobster industry. This approach has the support of fishers in certain southern Gulf of St. Lawrence communities.
- According to a fisherman in the area, 95 % of lobster fishers would favour a protection of this habitat because they consider this area unique.
- FRCC recommendations support any effort to protect lobster recruitment[h2].

Other associated essential habitats

- This habitat is of no specific interest for other species, but sites in the vicinity are of interest for lobster (berried females) and surf clam (see appendix).
- Lobster is associated with the following habitats of interest: Caraquet, Shippagan, Lameque and Miscou (3.3.1), Tracadie (3.3.2), Miramichi and Escuminac (3.3.3) and Cape Tormentine (3.3.5).

References

H1: MacNeil, J.L. & Assoc., 1998

H2: M. Lanteigne, p.c., 1999

H3: Lanteigne et al., 1998

H8: Jamieson et al., 1981

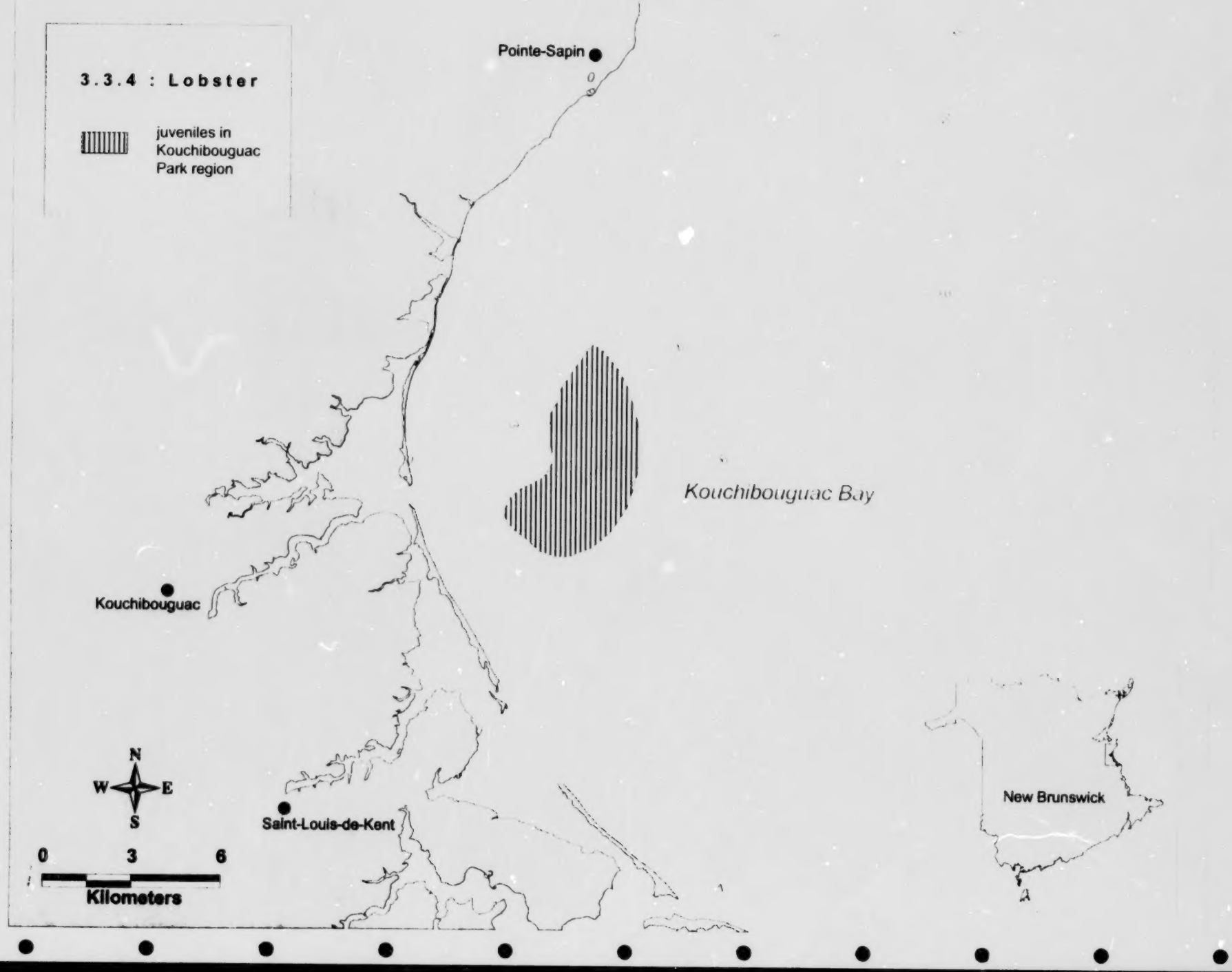
H9: Scarrat, 1975

H15: DFO (lobster), 1998

H16: FRCC, 1995

H17: DFO Statistics, 1998

H19: DFO Fishery officers, p.c., 1999


3.3.4 : Lobster
juveniles in Kouchibouguac Park region
Pointe-Sapin
Kouchibouguac Bay
Kouchibouguac
Saint-Louis-de-Kent
N
W
E
S
0
3
6
Kilometers
New Brunswick

3.3.5 Large-sized American lobster concentration in the Cape Tormentine area

Ecological Features

- Concentration of large sized American lobster and berried females located in Baie Verte and around Cape Tormentine (Figure 3.3.5).
- One of the two habitats known for their high concentrations of large-sized lobster [h2]. The other one is near Caraquet, Shippagan, Lameque and Miscou (3.3.1). Also known for a concentration of berried females[h1].
- The presence of large lobsters coincides with a surface current gyre [h10] associated with an area of high biological productivity.

Vulnerability, threats and human pressure

- Overexploitation of recruits and shortage of egg production [h3].
- Catches in the southern Gulf are slowly dropping since the records reached in 1990. In 1997, landings had fallen by 25% compared to 1990 [h15].
- In 1995, the FRCC concluded that lobster fishing was currently conducted at high exploitation rates, on immature lobsters, and did not allow adequate egg production [h16].
- Maintenance of adequate bottom could be jeopardized off Cape Tormentine because of a concentration of sea scallop in this area [h1](3.4.9) along with a sea scallop spat harvesting area [h1] that is in use. Dragging rough bottoms can have a serious adverse impact on lobster, with the proportion of captured and injured specimens reaching up to 12% [h8, h9].
- There are 100 to 150 scallop draggers fishing in the area[h19].
- Measures taken to protect this resource have helped to improve the situation, i.e. adding a biodegradable panel (1993) and a rectangular escape mechanism for sub-legal size lobsters (1995).
- There are several fishing wharves in this area [h11].
- Several beaches in the area (Cap-Pelé, Robichaud and Murray Corner) [h13].

Socio-economic characteristics

- American lobster is a commercially harvested species of high economic interest. It is the most important inshore fishery in the southern Gulf of St. Lawrence.
- Over the years lobster fishing became, and remains, an important factor in the social and economic development of Atlantic coastal communities and in particular those of the Gulf of St. Lawrence [h15].
- One of the problems perceived in the lobster fishing industry is the shared responsibility between two government levels: fishing (licenses, management) is under federal jurisdiction, while lobster processing plants come under provincial responsibility. The lack of collaboration between these two regulatory bodies

can indirectly have negative consequences on the fishing effort or on the fishers by creating economic expectations that do not match the stock status.

- Other commercially harvested species in the area include: lobster between August and October (125), herring in May and June (80), scallop between June and September (174), mackerel between May and August (5) and in July and August (60 recreational/days), flounder between April and December (12 with fixed gear, 4 with mobile gear), rock crab in May and June and between August and December (16), surf clam between April and June and between September and December (1000 recreational harvester/days and 40 commercial), clams between April and December (15 recreational harvester/days[h19].

Support, favourable and unfavourable factors

- The protection of certain inshore habitats can contribute to maintaining the diversity of ecosystems and the geographical particularities of lobster populations. Maintaining and protecting these biological features could be the basis of a sustainable development of the lobster industry. This approach has the support of fishers in certain southern Gulf of St. Lawrence communities.
- FRCC recommendations support any effort to protect lobster recruitment[h2].
- Possibility of a partnership with the Canadian Wildlife Service, which has interests in the area. This site is a good habitat for migrating shorebirds and waterfowl.
- A natural park and a national wildlife reserve were established in 1996 in nearby Cape Jourimain.
- This site covers an area with multiple provincial jurisdictions.

Other associated essential habitats

- The Cape Tormentine region is a habitat of interest for the following species: Atlantic herring (3.2.10), sea scallop (3.4.9), white hake (3.2.15) as well as Atlantic herring, surf clam, rock crab and gray seal (see appendix).
- Lobster is associated with the following habitats of interest: Caraquet, Shippagan, Lameque and Miscou (3.3.1), Tracadie (3.3.2), Miramichi and Escuminac (3.3.3) and Kouchibougouac (3.3.4).

References

H1: MacNeil, J.L. & Assoc., 1998

H2: M. Lanteigne, p.c., 1999

H3: Lanteigne et al., 1998

H8: Jamieson et al., 1981

H9: Scarrat, 1975

H10: Lauzier, 1965

H11: Hunter, 1975

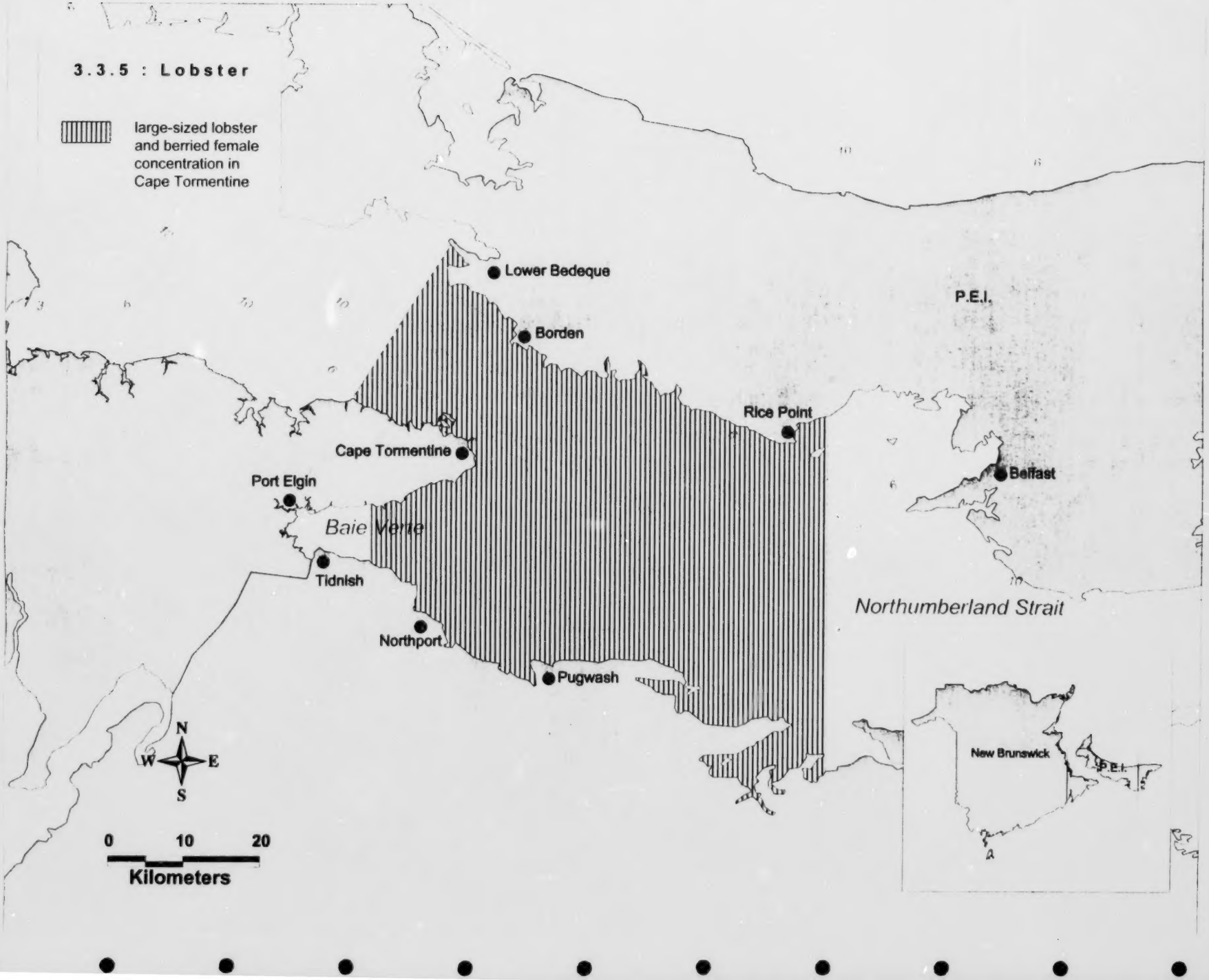
H13: Department of Tourism and Economic Development, 1998

H15: DFO (lobster), 1998

H16: FRCC, 1995

H17: DFO Statistics, 1998

H19: DFO Fishery officers p.c., 1999


3.3.5 : Lobster
large-sized lobster and berried female concentration in Cape Tormentine
Lower Bedeque
Borden
P.E.I.
Rice Point
Cape Tormentine
Belfast
Port Elgin
Baie Verte
Tidnish
Northumberland Strait
Northport
Pugwash
N
W
E
S
0
10
20
Kilometers
New Brunswick
P.E.I.

3.4.1 American oyster spat in Caraquet Bay

Ecological Features

- Major bed and concentration of oyster spat along with collection site in Caraquet Bay [u1] (Figure 3.4.1). The habitat boundaries are defined by larval surveys done in 1992 [u2, u3]. The resource is generally at a depth of 3 fathoms (5 m) or less [u1], but can reach 12.5 fathoms (20 m) [u4].
- One of the two main beds and spat collection sites for the aquaculture industry, the other being in Bouctouche Bay [u1] (3.4.3). There is also a high concentration of wild American oysters in Miramichi Bay [u1, u4] (3.4.2).
- Caraquet Bay is an extremely productive area, notably for American oyster and American lobster, due to barrier islands favouring the maintenance of higher water temperatures than in the rest of Chaleur Bay[u1].
- The southern Gulf of St. Lawrence is the northern limit of the species' distribution [u4].

Vulnerability, threats and human pressure

- The species is at its northern limit of distribution, and is therefore more sensitive to overexploitation, as recolonization may be more difficult in case of a sharp drop.
- The sandbar in Caraquet Bay is dynamic and could be jeopardized by erosion[u1]. In the summer of 1957, a channel was dredged in the western part of the dune to allow the passage of fishing boats; the channel subsequently filled itself in. Following the construction of the Maisonnette wharf in 1963, the channel reopened due to lack of sediment inflow [u5].
- The spat collection rate varies widely because of diverse environmental factors that could influence the movement and fixation of larvae, such as currents, winds, turbidity and water temperature.
- There are two major fishing wharves (Caraquet and Bas-Caraquet) in this area and several smaller ones[u5].
- Caraquet Bay is polluted by agricultural runoff, by municipal effluent outfalls, by fish plants, by effluent from a textile plant, by peat moss harvesting and by fishing wharves; due to pollution from some of these different sources, oyster beds in the bay had to be closed on several occasions (fecal contamination) [u6].
- Since 1993, the Caraquet Sustainable Development Group has taken a number of corrective actions to restore the ecological integrity of the bay. Cottage septic tank systems and the municipal wastewater collection system were improved, which allowed the re-opening of shellfish harvesting areas. An 80% gain in this sector was observed. At the urging of the group, peat harvesters installed

sedimentation ponds that reduced the amounts of suspended sediment from peat harvesting.

- Tourist activities in Caraquet Bay include boat tours and mollusc harvesting [u11].
- Malpeque disease (1957-58) eliminated up to 87% of the strains in Caraquet Bay [u14].
- There is channel dredging in Caraquet Bay.

Socio-economic characteristics

- American oyster is a commercially harvested species of high economic interest.
- Oyster harvesting is mostly a secondary fishing activity for lobster fishers.
- Historically, there was a large quantity of large oysters in Tabusintac and very good quality oysters in Shippagan harbour, in Saint-Simon and in Caraquet Bay. The ones in Caraquet Bay were reputed to be the best[u7].
- In 1852, Perley[u7] reached the conclusion that high quality oysters would soon disappear because of the harvesting pressure at the time.
- Today, the main traditional harvesting areas are in Bedeque Bay in PEI, in Caraquet Bay and in Miramichi Bay. Secondary areas are found in Bouctouche Bay [u4]. However, oyster farming has spread everywhere else in the Maritimes.
- Oyster harvesting requires a permit[u4].
- Apart from the current management tools (season and size), few attempts have been made to try to find ways to control oyster fishing in public sectors, basically because of the lack of an effective monitoring program for landings and a statistics gathering system that would identify the location of the fishing effort[u4].
- At present, there are 2177 commercial fishing licenses in NB for the fall fishery and 114 for the spring fishery [u4].
- The nature of this fishery makes it difficult to accurately estimate oyster landings from this site.
- The Caraquet Bay oyster bed is harvested by fishers who are mostly from other parts of the Acadian Peninsula.
- A spatfall prediction program set up by the New Brunswick Department Fisheries and Aquaculture provides successful spat collection for the many oyster growers using the site.
- Other commercially harvested species in the area include: lobster in May and June (3 fishers), smelt between October and February (20 commercial fishers) and between December and February (70 recreational fishers), surf clams between April and June and between September and December (100 recreational harvester/days), oyster between October and November (75 on public beds) and between September and March (40 fishers on private beds), soft shell clam between April and December (100 commercial harvesters), rock crab between May and June and between August and October (4) and eel between January and December (25 recreational fishers)[u12].

Support, favourable and unfavourable factors

- Fishers and aquaculture operators could approve the protection of this habitat because they are concerned about the state of the resource [u1].
- Since 1993, Caraquet Bay has been the focus of integrated management efforts by the New Brunswick Department of Fisheries and Aquaculture. Since 1993, the Caraquet Sustainable Development Group has taken a number of corrective actions to restore the ecological integrity of the bay.

Other associated essential habitats

- The Caraquet region is a habitat of interest for the following species: Atlantic mackerel (3.2.12) and lobster (3.3.1), as well as herring and surf clam (see appendix).
- American oyster is associated with the following habitats of interest: Miramichi (3.4.2) and Bouctouche (3.4.3).

References

U1: T. Landry, p.c., 1999
U2: Sephton and Booth, 1992
U3: Booth and Sephton, 1993
U4: DFO (oyster), 1996
U5: Chaussade, 1983
U6: Hunter, 1975
U7: Perley, 1852
U8: DFO Statistics, 1998
U11: Department of Tourism and Economic Development, 1998
U12: DFO Fishery officers, Caraquet, p.c. 1999
U14: Lavoie, 1977

3.4.1 : Oyster
concentration of spat in Caraquet Bay
Miscou Island
Chaleur Bay
Lamèque Island
Caraquet
New Brunswick
N
W
E
S
0
4
8
Kilometers
Gulf of St Lawrence

3.4.2 American oyster bed in Miramichi Bay

Ecological Features

- American oyster concentration and collection site in Miramichi Bay, between the barrier islands and Millbank [u1, u12] (Figure 3.4.2). The downstream boundary roughly consists of barrier islands that maintain a relatively warmer water temperature than to the east of the barrier islands, increasing the productivity of the estuary.
- Oysters are generally found at a depth of 3 fathoms (5 m) or less [u1], but can be found at depths of up to 12.5 fathoms (20 m) [u4]. Higher concentration areas were identified about twenty years ago [u13].
- Main concentration of wild American oysters on the east coast of NB [u1, u4]. The two main beds and collection sites for the oyster industry are in Caraquet (3.4.1) and Bouctouche Bay [u1, u4] (3.4.3).
- The southern Gulf of St. Lawrence is the northern limit of the species' distribution [u4].

Vulnerability, threats and human pressure

- The wild stock is subject to public harvesting. No resource enhancement efforts exist at the moment. A spat collection survey performed in 1999 in the Miramichi provided sufficient data to conclude that some sites have high potential. This study indicated that the Miramichi might be a promising site for spat collection, along with already established sites such as Bouctouche and Caraquet[u16].
- The success of oyster spat settlement varies due to numerous environmental factors that can influence the movement and fixation of larvae, such as currents, wind, turbidity and water temperature.
- Miramichi bay supported a larger population of American oysters in the past but Malpeque disease wiped out almost all the N.B. stocks in the early 50's [u1]. The actual oyster population originates from disease resistant broodstock brought in from Prince Edward Island in the 1960s.
- This bed is stable and this population is very important for other commercial fisheries; for example, the presence of molluscs promotes exchanges between the benthic and pelagic zones, which influences pelagic productivity [u1].
- The major sources of pollution on the Miramichi come from mining activities (Health Steele mine, located on a Northwest Miramichi tributary), pulp and paper mills (REPAP, Eagle, Acadia, Nelson Forest products) and wastewater from towns and villages[u10]. The problems associated with these pollutants are undetermined, but the suspected limiting factors include suspended sediments, sedimentation on the spawning ground and chemical pollution (metal, solvents, organic contaminants, etc). Wastewater could have an impact on dissolved

oxygen (increase in BOD, or biochemical oxygen demand). REPAP has recently improved its water treatment facility. Dioxins and furans effluents have met the guidelines since 1995, while suspended sediment criteria were met in 1997[u15].

- Most towns and villages now have water treatment facilities, but coliform levels remain high and have caused the closure of shellfish harvesting zones in the lower part of the estuary [u10]. In 1998,a new collector was also built at the Strawberry Marsh treatment plant for the north side of the city of Miramichi. Similar projects are being planned in the short term for the south side[u15]. A few houses and cottages only have septic tanks and discharge unclean wastewater in the river and its tributaries [u10].
- There are several former dumpsites in the Miramichi River basin that may be additional sources of pollution due to leaching.
- In 1981 and 1983, a navigation channel was dredged in the Miramichi (6.5×10^6 m^3 of sediment were dredged). The maintenance dredging of this channel is a potential source of habitat degradation. The increased turbidity of the water during dredging is a cause of concern, and the stability of the dumpsites has been questioned[u10].
- There are three such sites: a relatively stable one in the estuary between Newcastle and Chatham, a second located outside of the barrier islands at the mouth of the Miramichi River and a third one, which is unstable, in the inner bay [u10].
- There are two major ports on the Miramichi River: Newcastle and Chatham. Ore is no longer stored at these ports, eliminating unknown amounts of pollution from runoff and percolation.

Socio-economic characteristics

- American oyster is a commercially harvested species of high economic interest.
- Oyster fishing is mostly a secondary fishing activity for lobster fishers.
- In 1852, Perley[u7] reached the conclusion that high quality oysters would soon disappear because of the harvesting pressure at the time.
- Today, the main traditional harvesting areas are in Bedeque Bay in PEI, in Caraquet Bay and in Miramichi Bay. Secondary areas are found in Bouctouche Bay [u4]. However, oyster farming has spread everywhere else in the Maritimes.
- Oyster harvesting requires a permit[u4].
- Apart from the current management tools (season and size), few attempts have been made to try to find ways to control oyster fishing in public sectors, basically because of the lack of an effective monitoring program for landings and a statistics gathering system that would identify the location of the fishing effort[u4].
- At present, there are 2177 commercial fishing licenses in NB for the fall fishery and 114 for the spring fishery [u4].
- The nature of this fishery makes it difficult to accurately estimate oyster landings from this site.

- Commercially harvested species include lobster in May and June (180) and between August and October (60), mackerel between July and September (10 anglers), herring between April and June (55), oyster between September and November (375 on public beds), between September and March (8 growers) and between September and March (30 on private beds), smelt between October and February (25 fishers) and between December and February (5 recreational fishers), rock crab in May and June and between August and October (10), soft shell clam between April and December (900 recreational and 200 commercial harvesters), mussel between January and December (3 on private beds and 25 on public beds) and surf clam between April and June and between September and December (150 recreational and 50 commercial harvesters)[U12].

Support, favourable and unfavourable factors

- Fishers and aquaculture operators could approve the protection of the oyster habitat because they are concerned about the state of the resource [U1].
- The Miramichi watershed is an Environment Canada "ACAP" site (Atlantic Canada Coastal Action Program), which means it is already benefitting from integrated management efforts. The *MREAC* (*Miramichi River Environmental Assessment Committee*) has been working to restore the ecological integrity of the ecosystem since 1989.

Other associated essential habitats

- Miramichi Bay is a habitat of interest for the following species: striped bass (3.2.1), herring (3.2.7), lobster (3.3.3) and quahog (3.4.5), as well as blueback herring, American shad, eel, smelt, gaspereau, herring, sand lance, mackerel, smooth flounder, winter flounder, white hake, tomcod, surf clam, blue mussel, soft-shell clam, salmon and aquatic birds (see appendix).
- American oyster is associated with the following habitats of interest: Caraquet (3.4.1) and Bouctouche (3.4.3).

References

U1: T. Landry, p.c., 1999

U4: DFO (oyster), 1996

U5: Chaussade, 1983

U6: Hunter, 1975

U7: Perley, 1852

U8: DFO Statistics, 1998

U9: Eaton and Gray, 1994

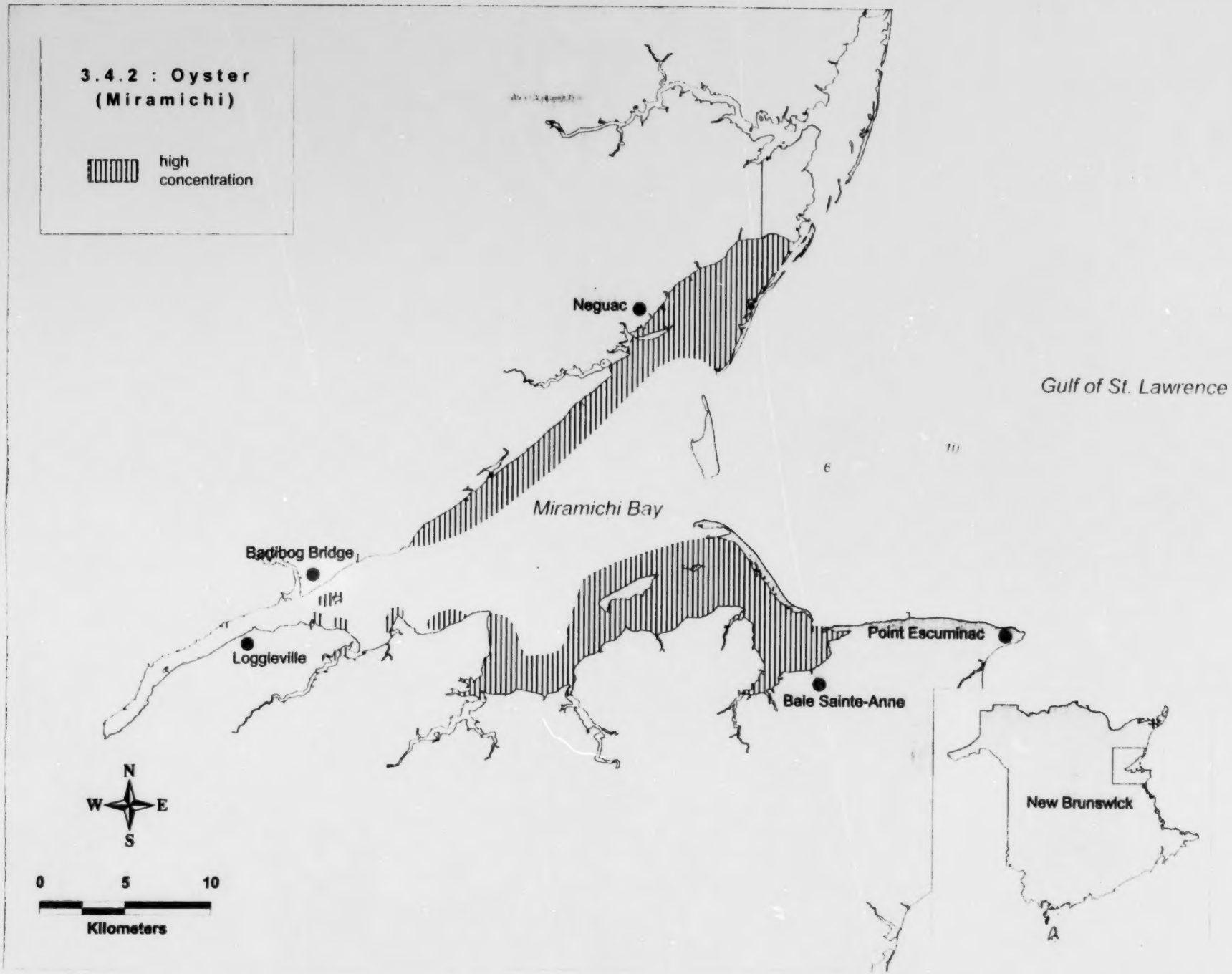
U10: Buckley, 1995

U12: DFO Fishery officers, Néguac and Baie Ste-Anne, p.c., 1999

U13: Philpott, 1978

U15: H. Collins, p.c., 1999

U16: M. Breau, p.c., 1999


3.4.2 : Oyster
(Miramichi)
high
concentration
Neguac
Gulf of St. Lawrence
Miramichi Bay
Badibog Bridge
Loggieville
Point Escuminac
Baie Sainte-Anne
New Brunswick
N
W
E
S
0
5
10
Kilometers

3.4.3 American oyster spat in Bouctouche Bay

Ecological Features

- Major bed and concentration of oyster spat, as well as collection site in Bouctouche Bay[u1] (Figure 3.4.3). A long sand dune forms the downstream boundary of this habitat. The resource is generally at a depth of 3 fathoms (5 m) or less [u1], but can be found in depths of up to 12.5 fathoms (20 m) [u4].
- One of the two main beds and collection sites for the oyster industry, the other being in Caraquet Bay[u1] (3.4.1). There is also a high concentration of wild American oysters in Miramichi Bay [u1, u4] (3.4.2).
- Bouctouche Bay is an extremely productive area due to the presence of barrier islands favouring the maintenance of higher water temperatures in the estuary than in the Northumberland Strait.
- The southern Gulf of St. Lawrence is the northern limit of the species' distribution [u4].

Vulnerability, threats and human pressure

- The stability of the Bouctouche dune system may be jeopardized by erosion[u1].
- The success of oyster spat settlement varies due to numerous environmental factors that can influence the movement and fixation of larvae, notably the currents, wind, turbidity and water temperature; collection in Bouctouche Bay is, however, one of the most stable in the Maritimes.
- Anthropogenic (human) sources of sediments upstream and downstream: wastewater, agriculture, construction (bridge, etc.), etc.
- All anthropogenic stress: navigation, tourism.
- During the construction of the old marina, this oyster bed had been greatly affected by turbidity and sedimentation. The site of the marina has since been rehabilitated. The impact it may have had on the oyster bed is unknown[u1].
- The impact of the construction of the new marina in 1998 is unknown.

Socio-economic characteristics

- American oyster is a commercially harvested species of high economic interest.
- Oyster fishing is mostly a secondary fishing activity for lobster fishers.
- In 1852, Perley[u7] reached the conclusion that high quality oysters would soon disappear because of the harvesting pressure at the time.
- Today, the main traditional harvesting areas are in Bedeque Bay in PEI, in Caraquet Bay and in Miramichi Bay. Secondary areas are found in Bouctouche Bay [u4]. However, oyster farming has spread everywhere else in the Maritimes.
- Oyster harvesting requires a permit[u4].

- Apart from the current management tools (season and size), few attempts have been made to try to find ways to control oyster fishing in public sectors, basically because of the lack of an effective monitoring program for landings and a statistics gathering system that would identify the location of the fishing effort[u4].
- At present, there are 2177 commercial fishing licenses in NB for the fall fishery and 114 for the spring fishery [u4].
- The nature of this fishery makes it difficult to accurately estimate oyster landings from this site.
- A spatfall prediction program set up by the New Brunswick Department Fisheries and Aquaculture provides for successful spat collection for the many oyster growers using the site.
- Commercially harvested species in the area include lobster in August and October (6), herring between April and June (2), oyster between September and December (15 on public beds) and between September and March (100 on private beds), smelt between October and March (20 commercial fishers) and between December and March (30 recreational fishers), gaspereau in June and July (10), soft shell clam between April and December (300 recreational and 20 commercial), surf clam between April and June and between September and December (40 recreational and 8 commercial) and eel between January and December (30 commercial fishers)[u12].

Support, favourable and unfavourable factors

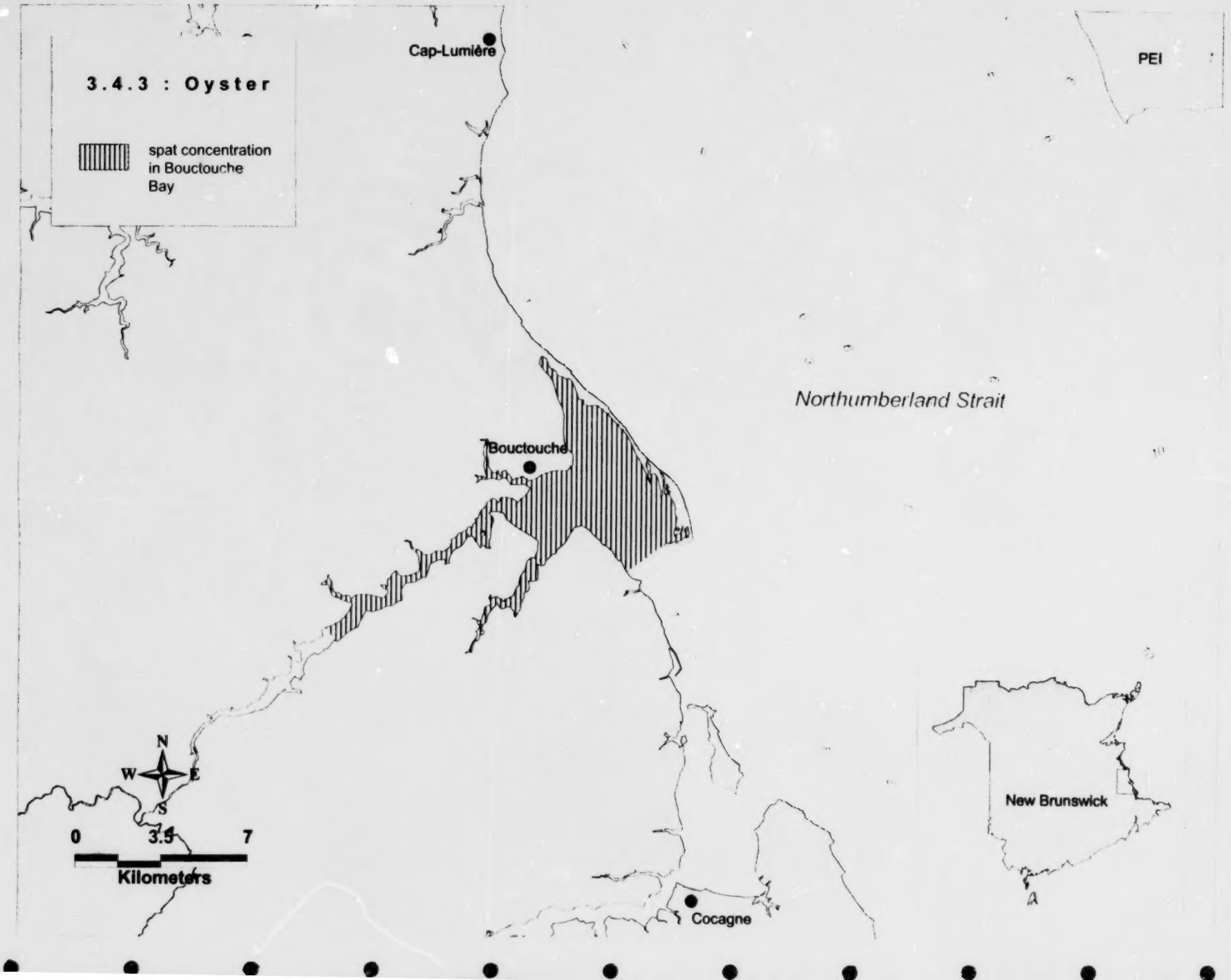
- American oyster and quahog could be threatened due to human activity [u1].
- Fishers and aquaculture operators could approve the protection of the oyster habitat because they are concerned about the state of the resource [u1].
- This bed is essential for the development of the New Brunswick aquaculture industry since a large part of the present oyster spat production is collected in this habitat [u1].
- The town of Bouctouche has been designated as a "model coastal town" and could favour protection (special status or management) of the resources in the bay.
- The Bouctouche Dune and adjacent salt marsh are now protected.

Other associated essential habitats

- Bouctouche Bay is a habitat of interest for the following species: Atlantic herring, quahog and soft-shell clam (see appendix).
- American oyster is associated with the following habitats of interest: Caraquet (3.4.1) and Miramichi (3.4.2).

References

U1: T. Landry, p.c., 1999
U4: DFO (oyster), 1996
U5: Chaussade, 1983
U6: Hunter, 1975
U7: Perley, 1852
U8: DFO Statistics, 1998
U12: DFO Fishery officers, Richibucto, p.c. 1999


3.4.3 : Oyster
spat concentration in Bouctouche Bay
Cap-Lumière
PEI
Northumberland Strait
Bouctouche
N
W
E
S
0
3.5
7
Kilometers
New Brunswick
Cocagne

3.4.4 Stimpson's surf clam bed on Miscou Bank

Ecological Features

- Stimpson's surf clam bed on Miscou Bank [S1] (Figure 3.4.4). The boundaries are extrapolated from results of exploratory harvesting done in 1990 [S2].
- Only known major bed near the east coast of NB, but is the smallest harvested bed in the Gulf [S2, S3]. It has an area of about 9.5 km^2 and is situated at depths of between 10.5 to 19 fathoms (17 and 31 m)[S2]. Mean and maximum densities recently obtained were 1.0 and 5.35 clams/m^2 [S2].
- Miscou Bank is a very productive habitat where several species of fish grow.
- Distribution is limited to benthic substrates with medium to coarse sediment at temperatures not exceeding 15 °C. Other important Gulf habitats are located on the Quebec North Shore, near PEI and near the Magdelen Islands.

Vulnerability, threats and human pressure

- Only known bed near the eastern coast of New Brunswick [S3].
- The surf clam is harvested with New England type hydraulic dragnets having 90% efficiency. Over 67% of mortality is due to damage to non harvested clams [S3].
- This mollusc has a relatively slow growth rate. Its life span varies between 30 and 40 years. Clams harvested during an experimental fishery in 1991 in the Gulf of St. Lawrence were 28 to 40 years old.

Socio-economic characteristics

- Stimpson's surf clam is a commercially harvested species of economic interest.
- The two fishers who harvest this resource do so on beds throughout the Gulf of St. Lawrence; they are not restricted to those near their home port, as opposed to colleagues from other areas who do not have access to the Miscou Bank.
- Stimpson's surf clam was harvested commercially in 1991, 1992, 1994 and 1995. Landings were then of 45,894kg, 213,176 kg, 264,496 kg and 4885 kg [S5].
- The commercial value was $20,234 in 1991, $140,993 in 1992, $144,562 in 1994, and $2693 in 1995.
- Commercially harvested species in the area include lobster in May and June (15), groundfish between August and November (50 recreational fisher/days), mackerel in July and August (50 angler/days) and herring between August and October (10)[S6].

Support, favourable and unfavourable factors

Other associated essential habitats

- Miscou Bank is a habitat of interest for the following species: capelin (3.2.2), herring (3.2.5), cod (3.2.14) as well as halibut, mackerel, cod and sea scallop (see appendix).
- Stimpson's surf clams are not associated with any other habitats of interest.

References

S1: T. Landry, p.c., 1999

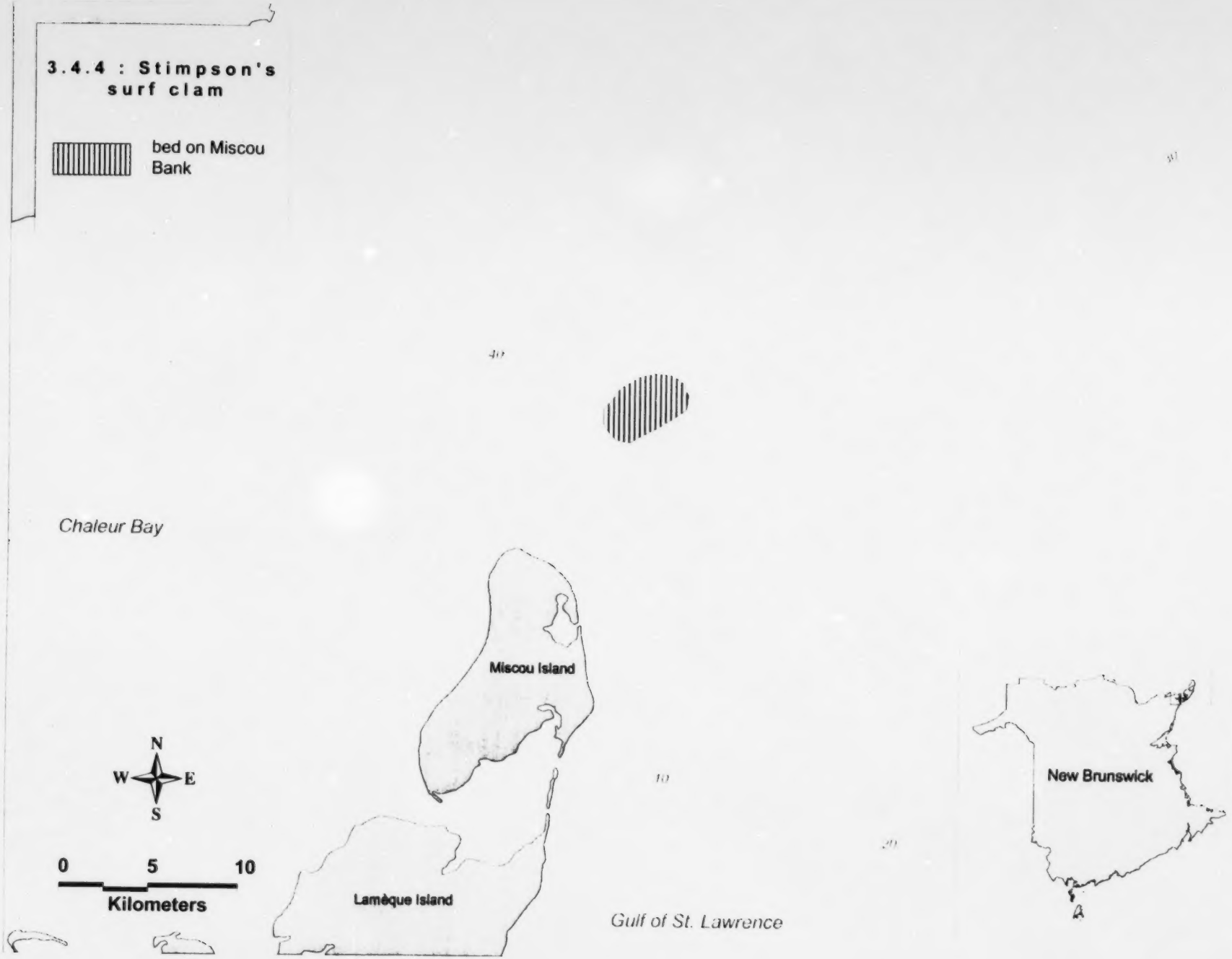
S2: Landry et al., 1992

S3: DFO (Stimpson's surf clam), 1996

S4: Hunter, 1975

S5: DFO Statistics, 1998

S6: Fishery officers, Shippagan and Laurentian Region, p.c. 1999


3.4.4 : Stimpson's surf clam
bed on Miscou Bank
Chaleur Bay
Miscou Island
Lamèque Island
Gulf of St. Lawrence
New Brunswick
N
W
E
S
0
5
10
Kilometers

3.4.5 Quahog bed in Miramichi Bay

Ecological Features

- Major quahog bed in Miramichi Bay [p1] (Figure 3.4.5). The habitat is delimited by the barrier islands at the downstream end of the bay. Higher concentration areas were identified about twenty years ago [p4]. The resource is generally in shallow waters, between the intertidal and sublittoral inshore limits [p2].
- This was the best known and most harvested bed until concentrations were drastically reduced by bacteria (QPX). The most harvested bed is now in Cocagne Bay [p1, p2] (see appendix). The species is at the northern limit of its distribution range, the natural limit of natural populations being Miramichi Bay [p2].

Vulnerability, threats and human pressure

- Being at its northern limit of distribution, this species is sensitive to overexploitation. Recolonisation would be more uncertain if a major decline should occur.
- Quahog could become a threatened species because of human activity [p1].
- There are almost no natural quahog beds left since they have disappeared in many bays. The main commercial beds are in Cocagne Bay and Miramichi Bay [p2].
- The major sources of pollution on the Miramichi are mining activities (Health Steele mine, located on a Northwest Miramichi tributary), pulp and paper mills (REPAP, Eagle, Acadia, Nelson Forest products) and wastewater from towns and villages[p6]. The problems associated with these pollutants are undetermined, but the suspected limiting factors include suspended sediments, sedimentation on the spawning ground and chemical pollution (metal, solvents, organic contaminants, etc). Wastewater could have an impact on dissolved oxygen (increase in BOD, or biochemical oxygen demand). REPAP has recently improved its water treatment facility. Dioxins and furans effluents have met the guidelines since 1995, while suspended sediment criteria were met in 1997[p8].
- Most towns and villages now have water treatment facilities, but coliform levels remain high and have caused the closure of shellfish harvesting zones in the lower part of the estuary [g28]. In 1998,a new collector was also built at the Strawberry Marsh treatment plant for the north side of the city of Miramichi. Similar projects are being planned in the short term for the south side[p8]. A few houses and cottages only have septic tanks and discharge unclean wastewater in the river and its tributaries [p6].
- There are several former dumpsites in the Miramichi River basin that may be additional sources of pollution due to leaching.
- In 1981 and 1983, a navigation channel was dredged in the Miramichi (6.5×10^6 m^3 of sediments were dredged). The maintenance dredging of this channel is a

potential source of habitat degradation. The increased turbidity of the water during dredging is a cause of concern, and the stability of the dumpsites has been questioned[p6].

- There are three such sites: a relatively stable one in the estuary between Newcastle and Chatham, a second located outside of the barrier islands at the mouth of the Miramichi River and a third one, which is unstable, in the inner bay[p6].
- Recent sampling in the channel has shown cadmium levels above acceptable limits for dumping at sea [p8].

Socio-economic characteristics

- Quahog is a commercially harvested species of economic interest, mostly as a secondary fishing activity for oyster fishers. [p2]
- Commercial fishing licenses are required since 1994 [p2].
- Landing statistics do not include recreational harvesting which is considerable in many areas [p2].
- Commercial landings of quahog have decreased by 50% between 1990 and 1995 in the Gulf [p2].
- For the entire eastern part of New Brunswick, quahog landings reached a peak of 307,631 kg in 1987; in 1998, they were only at 19 614 kg in 1998 [p3].
- Commercially harvested species include lobster in May and June (180) and between August and October (600), mackerel in July and August (100 anglers), herring between April and June (55), oyster between September and November (375 on public beds) and between September and March (30 private beds and 8 growers) smelt between October and February (25 commercial fishers) and between December and February (5 recreational fishers), rock crab in May and June and between August and October (10), soft shell clam between April and December (900 recreational/days and 200 commercial), mussel between January and December (3 on private beds and 25 on public beds), surf clam between April and June and between September and December (150 recreational/days and 50 commercial) and quahog between April and December (20 commercial fishers)[p7].

Support, favourable and unfavourable factors

- The Miramichi watershed is an Environment Canada "ACAP" site (Atlantic Canada Coastal Action Program), which means it is already benefitting from integrated management efforts. The *MREAC* (*Miramichi River Environmental Assessment Committee*) has been working to restore the ecological integrity of the ecosystem since 1989.

Other associated essential habitats

- Miramichi Bay is a habitat of interest for the following species: striped bass (3.2.1), herring (3.2.7), oyster (3.4.2), as well as blueback herring, American shad, eel, smelt, gaspereau, sand lance, Atlantic mackerel, white hake, smooth flounder, winter flounder, Atlantic tomcod, surf clam, blue mussel, soft shell clam, aquatic birds and salmon (see appendix).
- Quahog is also associated with the following habitats of interest: Bouctouche Bay, Cocagne, Shediac and Shemogue bays (see appendix).

References

P1: T. Landry, p.c., 1999

P2: DFO (quahog), 1996

P3: DFO Statistics, 1998

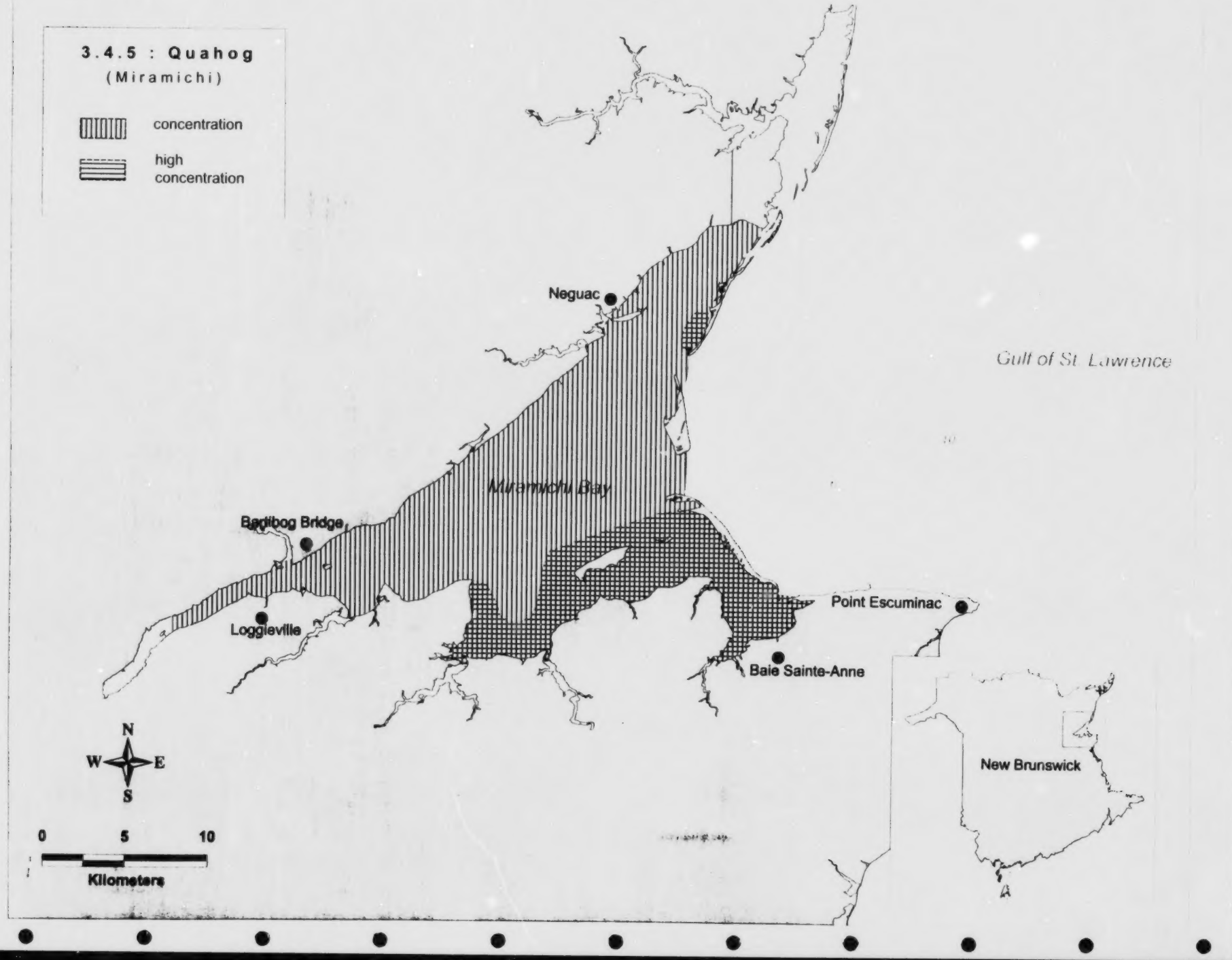
P4: Philpott, 1978

P5: Eaton and Gray, 1994

P6: Buckley, 1995

P7: DFO Fishery officers, Néguac and Baie St.Anne, p. c. 1999

P8: H. Collins, p. c. 1999


3.4.5 : Quahog
(Miramichi)
concentration
high concentration
Neguac
Gulf of St. Lawrence
Miramichi Bay
Bartibog Bridge
Loggieville
Point Escuminac
Baie Sainte-Anne
New Brunswick
N
W
E
S
0
5
10
Kilometers

3.4.6 Sea scallop spat in Nepisiguit Bay

Ecological Features

- Concentration of sea scallop spat in Nepisiguit Bay[t1] (Figure 3.4.6). Habitat boundaries are approximate because of spatio-temporal variations in spat abundance and site boundaries. Other concentrations may be present further offshore, in areas yet to be surveyed. The resource is generally present at depths of 3 to 25 fathoms (5 to 40 m) [t2].
- Main sea scallop spat concentrations in Chaleur Bay[t1].
- Chaleur Bay, especially the western part, is highly productive and is characterised by seasonal migrations of marine mammals, aquatic birds, fish (mackerel, salmon, tuna, etc.) and crustaceans (snow crab, etc.). There is a high species diversity of benthic marine algae, including large kelp beds, and more than 250 species of benthic organisms are found in the nearshore zone (mostly molluscs, amphipods and echinoderms) [t13].

Vulnerability, threats and human pressure

- Overexploitation and decrease of the population even if the spat concentrations in district 22 (Chaleur Bay- Escuminac) are stable [t2].
- There are a number of industries located on the northern and southern banks of the Chaleur Bay basin. Pulp and paper mills, mines, a smelter, a fertilizer plant, thermal power plants as well as a number of fish processing plants are located near the area[t6, t7, t8].
- Chaleur Bay as a whole is considered to be healthy, although there are local pollution problems, especially between Bathurst and Dalhousie[t6].
- The Belledune smelter produces effluents with toxic heavy metal content such as cadmium (Cd). The lobster fishery in Belledune harbour had to be closed on a number of occasions because of this problem[t7,t9]. In 1981, effluent cadmium concentrations had decreased by as much as 97%. In 1986, however, an increase in Cd concentrations was noticed in lobster, and concentrations remained high in 1987 and 1988. This contamination was caused by improper land filling techniques for contaminated wastes and a problem with one of the effluent pipes in the recycling system. The broken pipe was replaced in 1989, but it is still unknown if the measures taken were effective[t9]. The inner harbour is still closed to lobster fishing[t14].
- The fertilizer plant in Belledune discharges raw toxic effluent with low pH and high concentrations of fluoride and suspended sediment, with traces of nitrotoluene and other compounds, including heavy metals[t9]. This plant is presently closed[t14].
- PCI Chemicals in Dalhousie produces chlorine and caustic soda used by pulp and paper mills. This plant uses a mercury cathode process that, between 1976

and 1987, was responsible for discharging 5.3 tons of mercury into the environment[t9].

- Shellfish harvesting is closed in Bathurst Harbour because of high pollution.
- Pulp and paper mills reject liquid and gas effluents, as well as contaminated solid wastes[t7]. It should be noted that the Atholville and Dalhousie plants have improved their treatment facilities in the last 5 years.
- Pulp and paper mills produce more effluents (consisting of dissolved organic and inorganic compounds, suspended matter) than any other industry in the area[t9].
- The Dalhousie thermal power plant uses 20 000 tonnes of orimulsion per year. This oil-based emulsion in water has high polycyclic aromatic hydrocarbon (PAH) concentrations and may threaten benthic organisms, including scallop beds in the bay, if a spill occurs[t15].
- Fish plants located in the eastern portion of the bay produce effluents with high Biological Oxygen Demand (BOD). The effluents also have high bacterial counts and the plants also produce large quantities of solid wastes, which must be either dumped in the bay or on land[t9].
- There are two marinas located in the bay, one in Bathurst (100 boats) and one in Dalhousie (30 boats)[t10].
- Two major ports are also located in the area: Dalhousie (second largest port in New Brunswick) and Belledune (third largest port in the province). There are also a number of smaller fishing wharves.
- Tourism is also important in Dalhousie (sea kayaking, boat tours and ferry crossing to Miguasha), in Caraquet (boat tours, kayak and whale watching) and in Bathurst (excursions on the Nepisiguit River, boat tours)[t11].

Socio-economic characteristics

- Two First Nation communities are located on the southern shore of Chaleur Bay: Eel River Bar and Pabineau Fall, and two are located on the north shore (New Richmond and Maria).
- Sea scallop is a commercially harvested species of economic interest.
- The resource is overexploited everywhere in the southern Gulf[t2].
- No new licences have been issued since 1978 [t2].
- Most scallop fishers have more than one licence; they also fish lobster and herring[t2].
- Figures on catches are not very reliable; actual catches are unknown[t2].
- Commercially harvested species include lobster in May and June (3), scallop between June and September (15), and groundfish between August and November (100 recreational fishers)[t17].

Support, favourable and unfavourable factors

- Scallop fishers holding lobster-fishing licenses could favour increased protection of this habitat.

Other associated essential habitats

- The Nepisiguit Bay area is a habitat of interest for the following species: herring (3.2.3), as well as a spawning ground for herring, mackerel and cod (see appendix).
- Sea scallop is also associated with the following habitats of interest: Lamèque Island (3.4.7), Shediac Valley (3.4.8) and Cape Tormentine (3.4.9), as well as Miscou and the Northumberland Strait (see appendix).

References

T1: L. Lanteigne (SENPAQ), p.c.,1999

T2: DFO (scallop), 1998

T6: Hildebrand, 1984

T7: Breau, 1998

T8: Gagnon et al., 1997

T9: Eaton and Gray, 1994

T10: Washburn and Gillis, 1989

T11: Department of Tourism and Economic Development, 1998

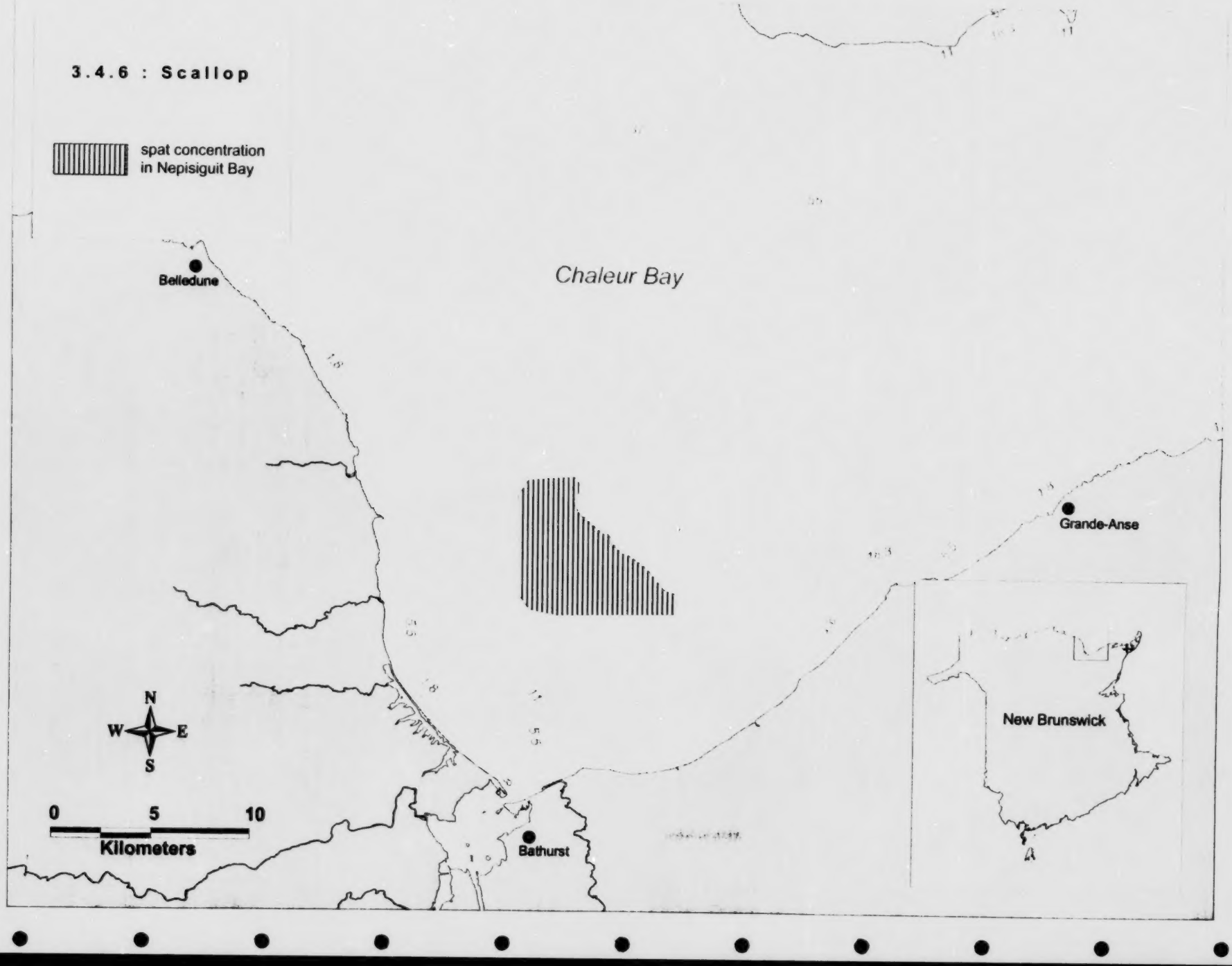
T12: DFO Statistics, 1998

T13: DFO (MPA Laurentian), 1998

T14: E. Ferguson, p.c., 1999

T15: Federal-Provincial-Territorial Advisory Committee, 1999

T17: DFO Fisheries officers, Bathurst, p.c. 1999


3.4.6 : Scallop
spat concentration in Nepisiguit Bay
Chaleur Bay
Belledune
Grande-Anse
Bathurst
New Brunswick
N
W
E
S
0
5
10
Kilometers

3.4.7 Sea scallop spat east of Lamèque Island

Ecological Features

- Concentration of sea scallop spat east of Lamèque Island[t1, t3] (Figure 3.4.7). The boundaries are approximate, and are based on data on spat collector density [t3]. The resource is generally at 3 to 25 fathoms (5 to 40 m) deep[t2]. This information comes from a single survey, but similar repetitive surveys in other areas have confirmed the re-occurring presence of spat in survey sites. Therefore, there is a strong probability that the information from the only survey done at this site is still valid [t3]. However, there may be some spatio-temporal variations in spat concentration and site boundaries. Some other large concentrations may also be present further offshore, in areas yet to be surveyed.
- The mouth of Miscou harbour is a productive area due to current exchanges between Chaleur Bay and Shediac Valley via this route. This habitat borders on Miscou Bank, a generally very productive area used by several species of fish as a spawning, nursery or feeding ground.

Vulnerability, threats and human pressure

- Overexploitation and decrease of the resource itself even if the spat concentrations for district 22 (Chaleur Bay- Escuminac) are stable [t2].

Socio-economic characteristics

- Sea scallop is a commercially harvested species of economic interest.
- The resource is overexploited everywhere in the southern Gulf[t2].
- No new licences have been issued since 1978[t2].
- Most scallop fishers have more than one licence; they also fish lobster and herring[t2].
- Figures for catches are not very reliable; actual catches are unknown[t2].
- Commercially harvested species include lobster in May and June (100), scallop between June and September (15), herring between August and October (40) and groundfish between August and November (5 anglers)[t17].

Support, favourable and unfavourable factors

- Scallop fishers holding lobster-fishing licenses could favour the protection of such an area (special status or management).

Other associated essential habitats

- The area east of Lameque Island is a habitat of interest for the following species: herring (3.2.5, 3.2.6), cod (3.2.14) and sea urchin (see appendix).
- Sea scallop is also associated with the following habitats of interest: Nepisiguit Bay (3.4.6), Shediac Valley (3.4.8) and Cape Tormentine (3.4.9), as well as Miscou and the Northumberland Strait (see appendix).

References

T1: L. Lanteigne (SENPAQ), p.c.,1999

T2: DFO (scallop), 1998

T3: L.-A. Davidson, p.c., 1999

T12: DFO Statistics, 1998

T17: DFO Fishery officers, p. c. 1999

3.4.7 : Scallop

spat concentration east of Lamèque Island
Chaleur Bay
Miscou Island
Lamèque Island
N
W
E
S
0
5
10
Kilometers
Gulf of St. Lawrence
New Brunswick

3.4.8 Sea scallop spat and high concentration in Shediac Valley

Ecological Features

- Concentration of sea scallop in the southern portion of Shediac Valley, between Miramichi Bay and Bouctouche[t3,t4], particularly east of Escuminac and Richibucto[t2,t3] (Figure 3.4.8). Because sea scallops are relatively mobile, the boundaries of this habitat are approximate[t3]. They are usually found between depths of 3 to 25 fathoms (5 m to 40 m)[t2].
- In the western portion of this area is a concentration of sea scallop spat, between Richibucto and Miramichi Bay [t3]. There may be some spatio-temporal variations in spat concentration and site boundaries. Some other large concentrations may also be present further offshore, in areas yet to be surveyed.
- The Miramichi Bay is a very productive sector where many species of fish, crustaceans and molluscs are present in large concentrations. This habitat takes in the gyre at the entrance to the Northumberland Strait[t5], *a* very productive area where sea scallop concentrations are particularly high[t2, t3].

Vulnerability, threats and human pressure

- Overexploitation and decrease of the resource itself even if the spat concentrations for district 22 (Escuminac- Baie Verte) are stable[t2].
- Extensive sea scallop dragging in this sector (150 boats)[t16]

Socio-economic characteristics

- Sea scallop is a commercially harvested species of economic interest.
- The resource is overexploited throughout the southern Gulf[t2].
- No new licences have been issued since 1978[t2].
- Most scallop fishers have more than one licence; they also fish lobster and herring[t2].
- Figures for the number of catches are not very reliable; actual catches are unknown[t2].
- Other commercially harvested species in the area include: lobster in May and June (120) and between August and October (225), scallop between May and September (120), groundfish between August and November (150 angler/days) and between April and November (9 with fixed gear), mackerel between June and August (130 fishers) and in July and August (74 angler/days), herring between July and September (645) and in April and May (220) and rock crab in May and June and between August and October (12)[t17].

Support, favourable and unfavourable factors

- Scallop fishers holding lobster-fishing licenses could favour the protection of such an area.

Other associated essential habitats

- The southern part of Shediac Valley is a habitat of interest for the following species: herring (3.2.6, 3.2.7 and 3.2.8), cod (3.2.13) and lobster (3.3.3), as well as winter flounder (see appendix).
- Sea scallop is also associated with the following habitats of interest: Nepisiguit Bay (3.4.6), Lamèque Island (3.4.7) and Cape Tormentine (3.4.9), as well as Miscou and the Northumberland Strait (see appendix).

References

T1: L. Lanteigne (SENPAQ), p.c.,1999

T2: DFO (scallop), 1998

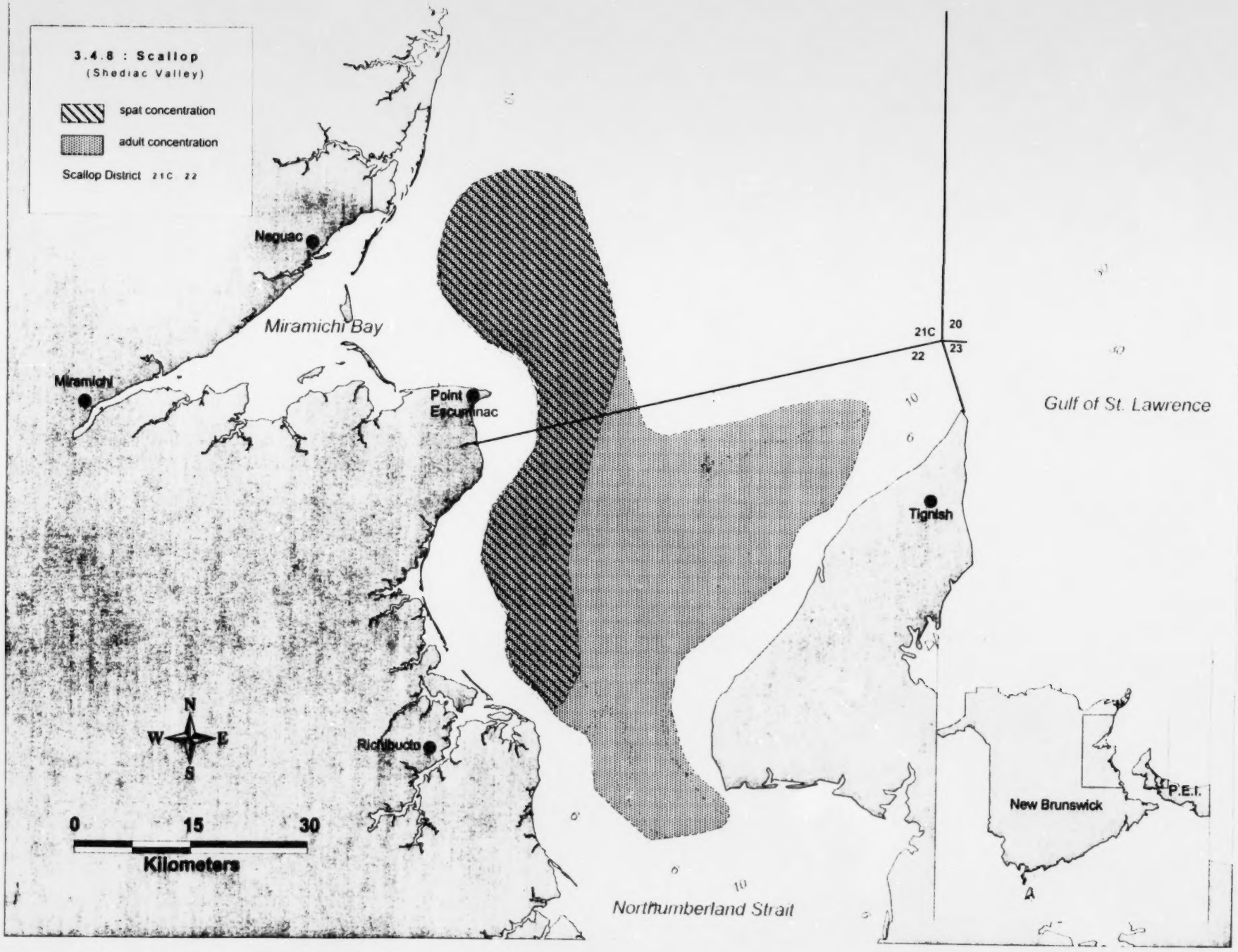
T3: L.-A. Davidson, p.c., 1999

T4: MacNeil, J.L.& Assoc., 1998

T5: Lauzier, 1965

T12: DFO Statistics, 1998

T17: DFO Fishery officers, Baie Ste-Anne, Richibucto and PEI, p.c. 1999


3.4.8 : Scallop
(Shediac Valley)
spat concentration
adult concentration
Scallop District 21C 22
Neguac
Miramichi Bay
Miramichi
Point Escuminac
21C
20
22
23
Gulf of St. Lawrence
Tignish
N
W
E
S
Richibucto
0
15
30
Kilometers
Northumberland Strait
New Brunswick
P.E.I.

3.4.9 Sea scallop high concentration in Cape Tormentine

Ecological Features

- Concentration of sea scallop off Cape Tormentine[t2,t3, t4] (Figure 3.4.9). Because sea scallops are relatively mobile, the area included in this habitat can only be approximately estimated[t3]. The resource is generally at 3 to 25 fathoms (5 to 40 m) deep[t2].
- This habitat borders a surface current gyre[t5], which is usually associated with areas of high biological productivity.

Vulnerability, threats and human pressure

- Overexploitation and decrease of the resource in district 22 (Escuminac-Baie Verte)[t2].
- Effluents from fish plants in Cap-Pelé and along the coast probably affect this habitat; these effluents contain high bacterial concentration[t16].
- There are several fishing wharves in this area[t16].
- Several beaches in the area (Cap-Pelé, Robichaud and Murray Corner)[t11].

Socio-economic characteristics

- Sea scallop is a commercially harvested species of economic interest.
- The resource is overexploited throughout the southern Gulf[t2].
- No new licences have been issued since 1978[t2].
- Most scallop fishers have more than one licence; they also fish lobster and herring[t2].
- Figures for the number of catches are not very reliable; actual catches are unknown[t2].
- Commercially harvested species include lobster between August and October (125), scallop between May and September (174 fishers), groundfish between April and December (12 with fixed gear and 4 with mobile gear), surf clam between April and June and between September and December (50), mackerel in July and August (10 anglers/day) and between May and August (5 fishers), herring between August and October (70) and rock crab in May and June and between August and October (4)[t17].

Support, favourable and unfavourable factors

- Possibility of a partnership with the Canadian Wildlife Service, which has interests in the area. This site is a good habitat for migrating shorebirds and waterfowl.

- A natural park and a national wildlife reserve were established in 1996 in nearby Cape Jourimain.
- Scallop fishers holding lobster-fishing licenses could favour some form of protection of this habitat
- This site covers an area with multiple provincial jurisdictions.

Other associated essential habitats

- Cape Tormentine is a habitat of interest for the following species: herring (3.2.10), white hake (3.2.15), lobster (3.3.5) and surf clam (see appendix).
- Sea scallop is also associated with the following habitats of interest: Nepisiguit Bay (3.4.6), Lamèque Island (3.4.7) and Shediac Valley (3.4.8), as well as Miscou and the Northumberland Strait (see appendix).

References

T2: DFO (scallop), 1998

T3: L.-A. Davidson, p.c., 1999

T4: MacNeil, J.L.& Assoc., 1998

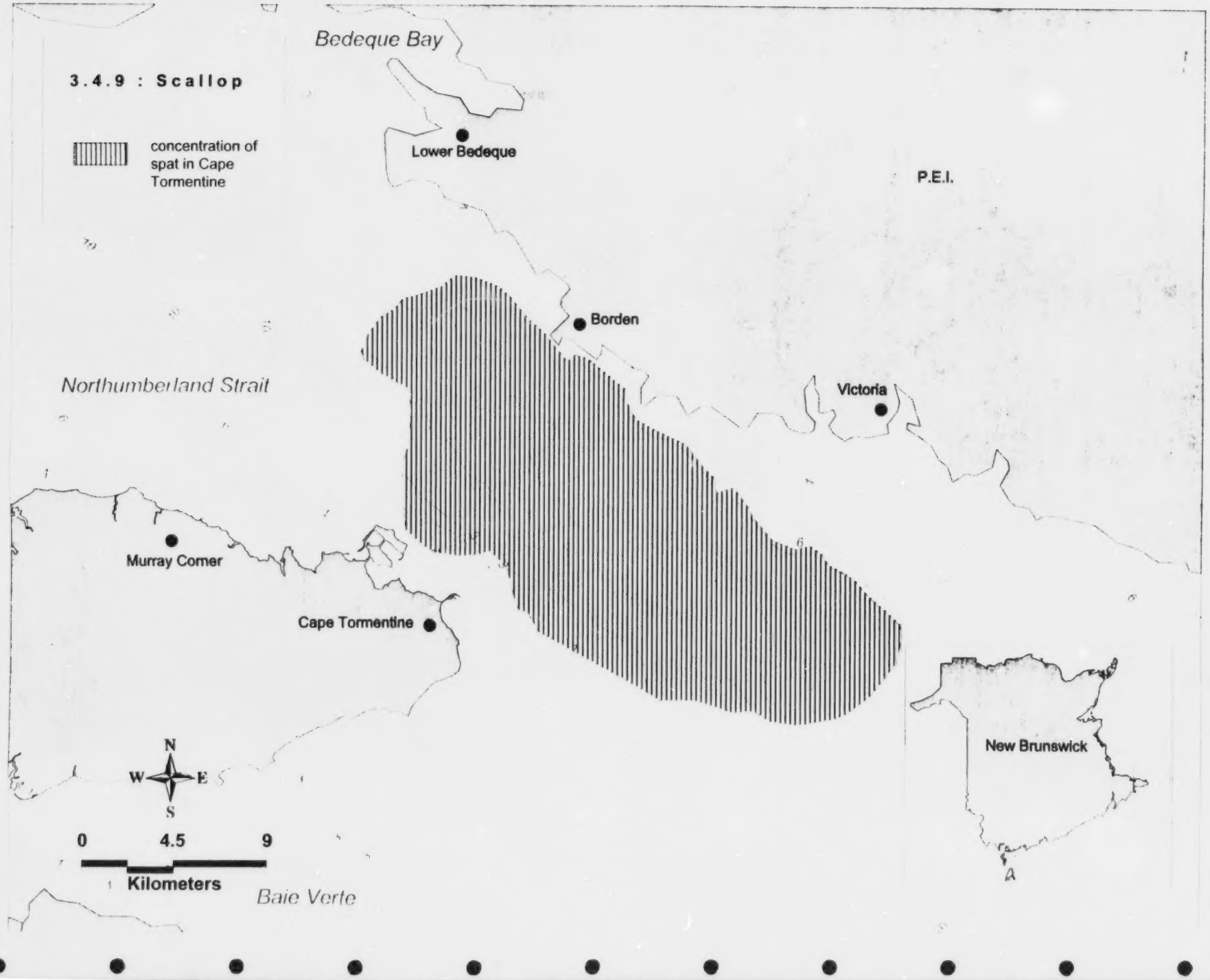
T5: Lauzier, 1965

T11: Department of Tourism and Economic Development, 1998

T12: DFO Statistics, 1998

T16: Hunter, 1975

T17: DFO Fisheries officers, p.c., 1999


3.4.9 : Scallop
concentration of spat in Cape Tormentine
Bedeque Bay
Lower Bedeque
P.E.I.
Borden
Victoria
Northumberland Strait
Murray Corner
Cape Tormentine
New Brunswick
N
W
E
S
0
4.5
9
Kilometers
Baie Verte

4. DISCUSSION

This chapter summarizes the information presented in the fact sheets and the appendices in a geographical grouping. This is followed by a brief analysis of the ecological and socio-economic characteristics of these habitats.

4.1 Geographical synthesis

Table 1 gives a synthesis of essential habitats according to location and species concerned. The figures 4.1 to 4.3 show the overlapping essential habitats within each ecozone.

The Chaleur Bay ecozone contains nine essential habitats, sheltering 14 species or groups of species of interest. Eight fact sheets and 10 maps (appendix) depict the areas in this ecozone. The Northumberland Strait ecozone has 10 essential habitats, containing 13 species or groups of species of interest and is illustrated by 9 fact sheets and 11 different maps. The Shediac Valley ecozone has 11 essential habitats, and contains all 31 species or groups of species of interest, as described in 18 fact sheets and 24 maps.

Six (6) essential habitats stand out overall in eastern New Brunswick by the high number of fact sheets or maps that list them. It should be noted that the frequency of occurrence does not determine the relative importance of habitats, and is more a function of the quantity of available information. Nonetheless, habitats linked to several species suggest that they have some productive value and high biodiversity.

The Miramichi watershed is highly distinct from the other habitats. It is followed by the Miscou Bank, the Kouchibouguac and Richibucto areas. Cape Tormentine and Baie Verte have a similar frequency of occurrence in the analysis.

Miramichi

The Miramichi drainage basin is elliptical in shape and stretches 190 km east to west and 95 km north-south. The estuarine or salt-water portion of the basin extends from the barrier beach, with the salt wedge reaching about 44 km upstream. The total drainage area, from the barrier islands upstream, is 14 000 km^2. The river flow varies, with the mean annual discharge calculated at 3 000 m^3/s. The estuarine portion of the system is relatively shallow (4 to 8 m), except in bends, where stronger currents deepen the bottom to depths of up to 14 m. Hydrodynamics are such that most moving sediments tend to accumulate in

a low energy area off Point aux Carr, named the Grand Dune Flat. Fresh and salt water mix quickly in the Miramichi. Tidal amplitude is approximately 1 m. This habitat is distinguished by several characteristics:

- It contains the only confirmed spawning ground in the southern Gulf for striped bass, a species in difficulty, although it has not yet been officially declared threatened;

- It is used by many species: 21 listed in 6 facts sheets and 10 maps, to which are added 24 less abundant species, but that are nonetheless found in the estuary (Hanson and Courtenay, 1995);

- It has been the topic of many research and data collection projects which, on one hand, explains why there is so much information available, and, on the other hand, reflects the richness of this environment, which supports numerous commercial fisheries. The barrier islands partially isolate the estuary from the harsher conditions of the Northumberland Strait and contribute to maintaining a unique habitat characterized by higher water temperatures, more stable environmental conditions (weaker winds, currents) and frequent exchanges between fresh and salt waters as a result of tidal motion.

TABLE 1. **List of fact sheets and of annexes and synthesis of criteria by geographic site in northeastern New Brunswick.**

Location / Species	ZONE 1									ZONE 3				
	West of Chaleur Bay	New Mills	Heron Island	Nepisiguit Bay	Caraquet	West of Lameque and Miscou Islands	Shippagan Bay	Miscou Harbour	Chaleur Bay	MelBays of Miscou Island	Miscou Bank	East of Miscou Island	Lameque Island	Tracadie Region
American eel														
American lobster					3.3.1F	3.3.1F	3.3.1F							
American oyster					3.4.1F									3.3.2F
American sand lance														
American shad														
Aquatic birds			3.5.2A		3.5.2A			(3.1.1F)		3.5.3A		(3.1.2F)		3.5.2A, 3.5.4A
Atlantic cod	3.2.24A			3.2.24A					3.2.24A		3.2.14, 3.2.24A	3.2.24A		
Atlantic halibut											3.2.19A			
Atlantic herring	3.2.3F	3.2.3F, 3.2.4F	3.2.3F	3.2.3F, 3.2.20A	3.2.20A	3.2.20A		(3.1.1F)			3.2.5F, 3.2.6F	3.2.5F	3.2.5F	
Atlantic mackerel	3.2.23A	3.2.23A	3.2.23A	3.2.23A	3.2.23A	3.2.23A	3.2.12, 3.2.23A	(3.1.1F)	3.2.23A		3.2.23A			
Atlantic salmon														
Atlantic tomcod														
Blue mussel							3.4.13A							
Blueback herring														
Capelin								(3.1.1F)			3.2.2F	3.2.2F		
Common seal														
Gaspereau														
Gray seal														
Green sea urchin			3.4.18A			3.4.18A							3.4.18A	
Harbour porpoise											3.5.1A			
Kelp			3.1.3F											
Quahog														
Rainbow smelt								(3.1.1F)						
Rock crab														
Sea scallop				3.4.6F		3.4.20A					3.4.20A	3.4.7F	3.4.7F	
Smooth flounder														
Soft shell clam			3.4.15A											
Stimpson's surf clam											3.4.4F			
Striped bass								(3.1.1F)				(3.1.2F)		
Surf clam					3.4.10A									
White hake														
Winter flounder							3.2.27A	(3.1.1F)				3.2.27A	3.2.27A	3.2.27A

F : fact sheet A : annexes ( ) : species probably present in a particular habitat (fact sheets 3.1.1 à 3.1.3)

TABLE 1 *(con'd).* **List of fact sheets and of annexes and synthesis of criteria by geographic site in northeastern New Brunswick.**

Location / Species	Zone 3 *(con'd)*						Zone 2									
	Miramichi Basin	Mouth of Miramichi	Escuminac Point	Kouchibouguac	Shediac Valley	Bradelle and Orphan Banks	Richibucto	Bouctouche	Cocagne	Shediac	Cap Pelé	Shemogue	Murray Beach	Cape Tormentine	Baie Verte	Northumberland Strait
American eel	3.2.16A															
American lobster	3.3.3F	3.3.3F	3.3.3F	3.3.4F									3.3.5F	3.3.5F	3.3.5F	
American oyster	3.4.2F, (3.1.3F)							3.4.3F								
American sand lance	3.2.17A															
American shad	3.2.16A															
Aquatic birds	3.5.4A			3.5.4A			3.5.4A									
Atlantic cod					3.2.13F											
Atlantic halibut																
Atlantic herring	3.2.7F, 3.2.17A	3.2.7F	3.2.7F	3.2.21A	3.2.6F		3.2.8F, 3.2.21A	3.2.22A	3.2.22A	3.2.22A	3.2.9F		3.2.10F	3.2.22A	3.2.22A	
Atlantic mackerel	3.2.17A				3.2.11F	3.2.11F										
Atlantic salmon	3.2.16A															
Atlantic tomcod	3.2.16A, 3.2.17A, 3.2.18A															
Blue mussel	3.4.14A	3.4.14A														
Blueback herring	3.2.16A, 3.2.17A															
Capelin																
Common seal				3.5.5A												
Gaspereau	3.2.16A, 3.2.17A															
Gray seal	3.5.6A	3.5.6A	3.5.6A	3.5.5A, 3.5.6A	3.5.6A		3.5.6A						3.5.7A	3.5.7A	3.5.7A	
Green sea urchin			3.4.19A													
Harbour porpoise																
Kelp																
Quahog	3.4.5F							3.4.22A	3.4.22A	3.4.22A		3.4.22A				
Rainbow smelt	3.2.16A, 3.2.17A, 3.2.18A															
Rock crab				3.3.6A				3.3.7A			3.3.7A	3.3.7A	3.3.7A	3.3.7A	3.3.7A	
Sea scallop		3.4.8F			3.4.8F									3.4.9F		3.4.21A
Smooth flounder	3.2.26A, 3.2.17A, 3.2.25A															
Soft shell clam	3.4.16A						3.4.17A	3.4.17A								
Stimpson's surf clam																
Striped bass	3.2.1F, 3.2.17A															
Surf clam	3.4.11A	3.4.11A		3.4.11A			3.4.11A						3.4.12A	3.4.12A	3.4.12A	
White hake	3.2.17A													3.2.15F	3.2.15F	
Winter flounder	3.2.17A, 3.2.26A	3.2.26A	3.2.26A													

F : fact sheet A : annexes ( ) : species probably present in a particular habitat (fact sheets 3.1.1 à 3.1.3)

Figure 4.1 : Overlapping essential habitats within the Chaleur Bay ecozone

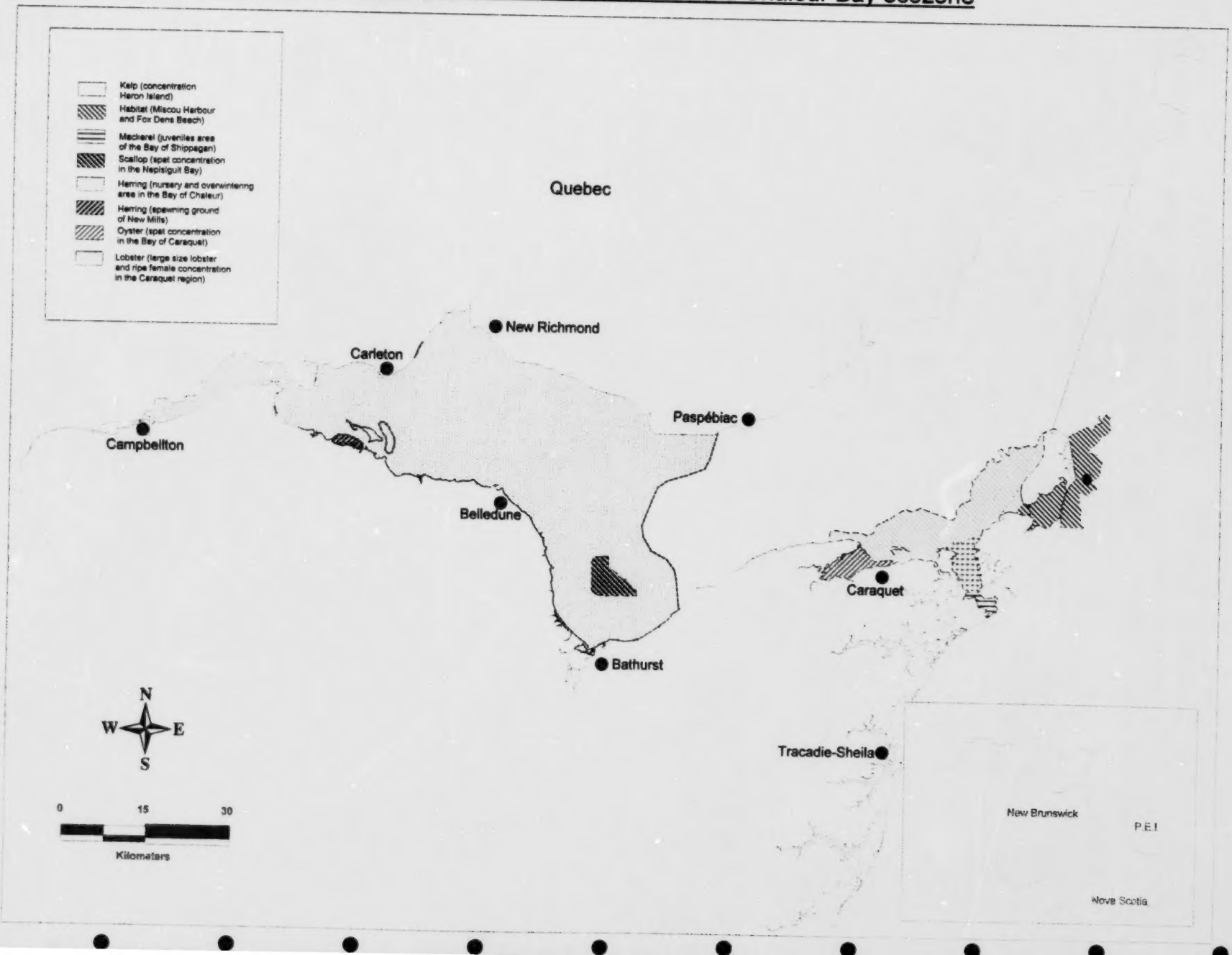


Figure 4.2 : Overlapping essential habitats within the Shediac Valley ecozone

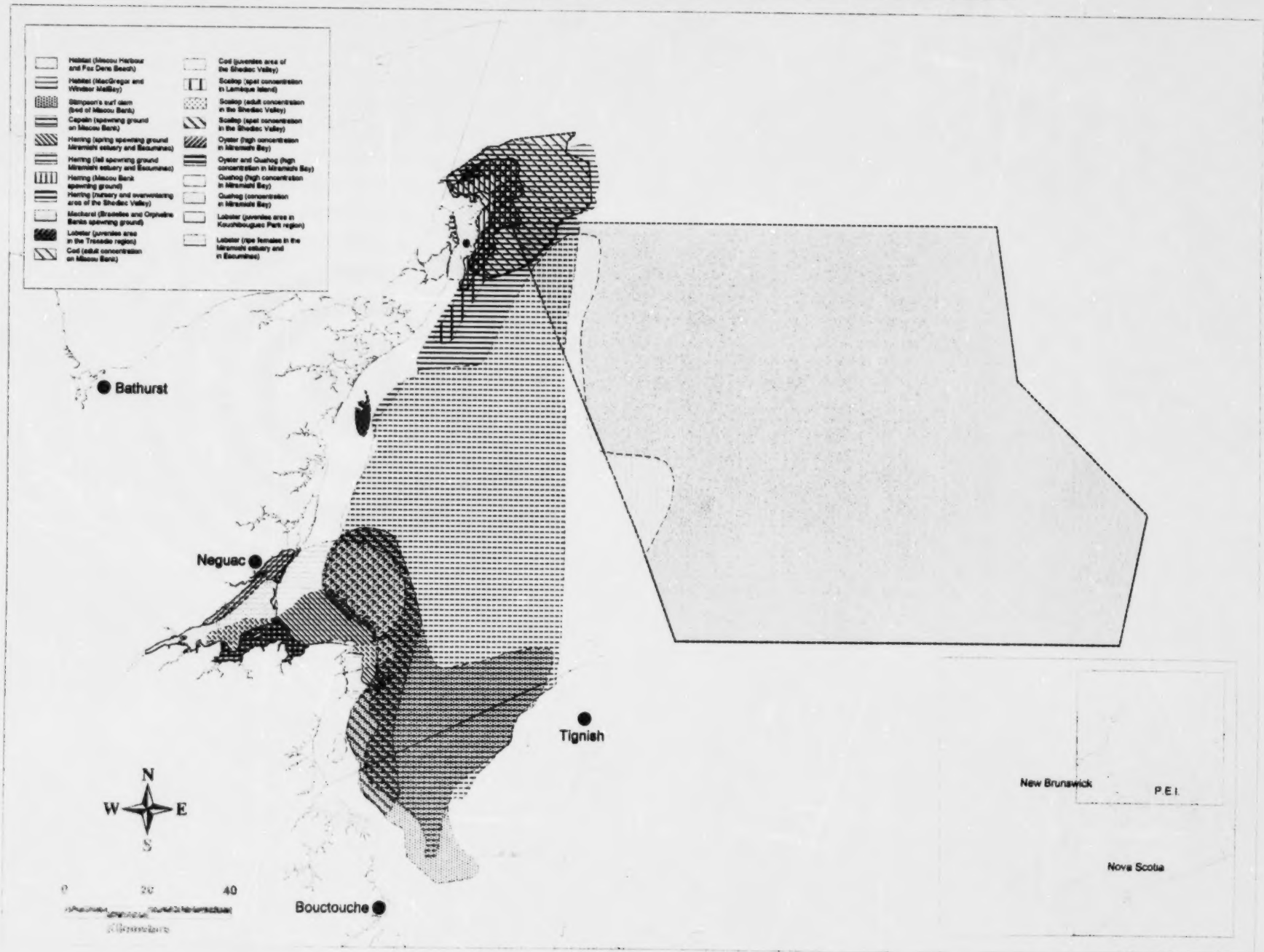
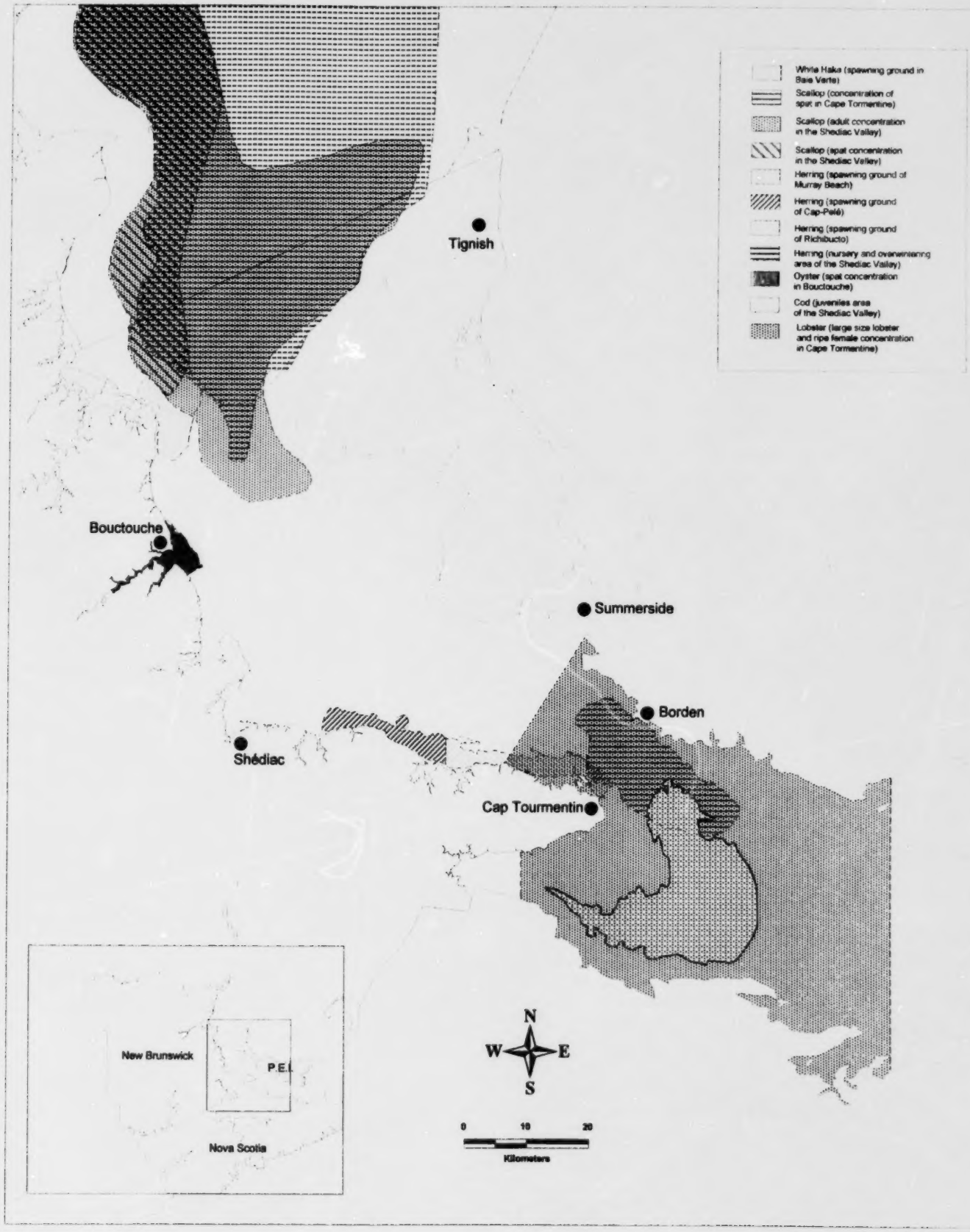

Habitat (Miscou Harbour and Fox Dens Beach)
Habitat (MacGregor and Windsor MalBay)
Stimpson's surf clam (bed of Miscou Bank)
Capelin (spawning ground on Miscou Bank)
Herring (spring spawning ground Miramichi estuary and Escuminac)
Herring (fall spawning ground Miramichi estuary and Escuminac)
Herring (Miscou Bank spawning ground)
Herring (Hatnary and overwintering area of the Shediac Valley)
Mackerel (Bradelles and Orphelins Banks spawning ground)
Lobster (juveniles area in the Tracadie region)
Cod (adult concentration on Miscou Bank)
Cod (juveniles area of the Shediac Valley)
Scallop (spat concentration in Lamèque Island)
Scallop (adult concentration in the Shediac Valley)
Scallop (spat concentration in the Shediac Valley)
Oyster (high concentration in Miramichi Bay)
Oyster and Quahog (high concentration in Miramichi Bay)
Quahog (high concentration in Miramichi Bay)
Quahog (concentration in Miramichi Bay)
Lobster (juveniles area in Kouchibouguac Park region)
Lobster (ripe females in the Miramichi estuary and in Escuminac)
Bathurst
Neguac
Tignish
Bouctouche
N
W
E
S
0
20
40
New Brunswick
P.E.I.
Nova Scotia

Figure 4.3 : Overlapping essential habitats within the Northumberland Strait ecozone



Miscou Bank

Miscou Bank is a plateau northeast of Miscou Island, located at the western end of the Gaspé Basin, where secondary productivity is high. This specific hydrodynamic system is described as a basin that traps the marine current in a cul-de-sac (DFO, 1998F); as a result, the zooplankters (krill) carried there accumulate and serve as food for numerous pelagic fish (herring, capelin, mackerel) which, in turn, feed ichthyophagous species (whales and other fish). This habitat:

- contains the only known bed of Stimpson's surf clam and the only capelin spawning ground in the study region;

- is named in five (5) fact sheets and five (5) maps on eight (8) species of interest, not to mention the species that migrate through this very productive habitat. Located at the junction between Chaleur Bay and Shediac Valley, it benefits from the positive influence of the current gyre present in this region and serves as a spawning ground for capelin, herring and mackerel, as well as a nursery for herring and cod.

Kouchibouguac

The Kouchibouguac system consists of two rivers, Kouchibouguac and Black, their estuaries and a vast dune system. The Kouchibouguac drainage basin covers 177 km^2. The Black River drainage basin covers 51 km^2. Many marshes, swamps, peat bogs and salt marshes are found along these slow-moving rivers. Mean tidal amplitude is 0.67 m. Black River has a maximum depth of 1.5 m. The Kouchibouguac River channel has a mean depth of 3 m. Shallow flats are often observed in the lower portion of the estuary, near the dunes. There are no major industries in the area, and part of the dune system is protected by Kouchibouguac National Park. This habitat is found on 1 fact sheet and six (6) maps relating to seven (7) species of interest, not to mention the species that migrate through this very productive habitat, as demonstrated by its national park status. Like Miramichi, but on a smaller scale, productivity is favoured by the presence of sand dunes.

Richibucto

The Richibucto area, like Kouchibouguac, consists of rivers (St. Charles, Richibucto, St. Nicholas) flowing into an estuary protected by barrier islands. This habitat is present on one (1) fact sheet and five (5) maps for five (5) species of interest. Again, the presence of barrier islands favours a very productive environment.

The mouth of the Miramichi

This habitat is listed on three (3) fact sheets and three (3) maps with respect to five (5) species of interest. It is located outside of the barrier islands, with exchanges of water increasing local productivity. It includes, up to Escuminac Point, the main spawning ground for the spring herring stock and the second largest for the fall stock.

Cape Tormentine and Baie Verte

These two habitats are neighbours and have similar characteristics. They are listed on three (3) fact sheets and four (4) maps concerning six (6) species of interest. They are located near a current gyre that increases local productivity by the exchanges of water masses it creates.

Other habitats

Two other habitats are worth noting, as they are mentioned 6 times in the fact sheets or maps: Caraquet and Point Escuminac. Furthermore, Shediac Valley, in spite of a lower number of references (5), is nevertheless referred to in four (4) fact sheets and deserves special attention.

Caraquet Bay, like many of the previously mentioned sites, consists of a river flowing into an estuary protected by sand dunes. It is one of the main oyster farming areas in New Brunswick.

Point Escuminac is influenced by the exchanges of water masses generated by the current gyre located south of the area and by Miramichi Bay. It contains the main spawning ground for spring herring stocks and second largest for fall stocks.

Shediac Valley is a large open zone, characterized by the presence of herring and Atlantic cod nurseries, high concentrations of sea scallop spat and harvestable sea scallop, as well as a portion of the main Atlantic mackerel spawning ground.

4.2 Ecological synthesis

Certain essential habitats (spawning ground, nursery) for key components of the life cycle of certain species stand out by their relative importance or by their uniqueness in northeastern NB. The summary of these habitats, from north to south, is as follows:

- The western portion of Chaleur Bay, main nursery and overwintering area for juvenile Atlantic herring;

- MacGregor and Windsor Malbays in Miscou Island, unique habitats due to the very low fresh water supply they receive and the resulting warm water temperatures, which increase their productivity;

- Miscou Bank, main known capelin spawning ground, main spawning ground for fall herring stocks and main known Stimpson's surf clam bed;

- Shippagan Bay, main known juvenile Atlantic mackerel concentration;

- Bradelle and Orphan banks, main known Atlantic mackerel spawning ground;

- Shediac Valley, main known juvenile Atlantic cod concentration;

- Miramichi River watershed, only known spawning ground for striped bass in the southern Gulf, main natural concentration of wild American oyster and main quahog concentration;

- the portion of the Miramichi estuary located outside the barrier islands and Point Escuminac, main spawning ground for spring herring stocks and main American lobster berried female concentration;

- Baie Verte, main known white hake spawning ground, the habitat being characterized by less important densities since the decline of the resource.

The ecological value of these habitats is not the only factor to be considered in determining their relative importance. Like the number of mentions in the data sheets or maps, it is, to some extent, a reflection of the amount of information available and the current state of knowledge. It is nevertheless an indicator that should be taken into account if habitats are to be classified for management or for any other purposes.

During the June 1999 workshop held to review and improve the draft version of this document, it was agreed that the special value of the Shediac Valley inshore area should be stressed. The zone extending from shore to a depth of 20 fathoms (32 m) is characterized by a high productivity. Currents and dominant winds promote the retention of fish, molluscs and crustacean larvae in the area. Several fact sheets include this area, as shown in Figure 4.1. They include: Herring nursing and overwintering area (3.2.6), herring spawning ground in Miramichi and Escuminac (3.2.7), juvenile cod concentration in the Valley (3.2.13), egg carrying female lobster

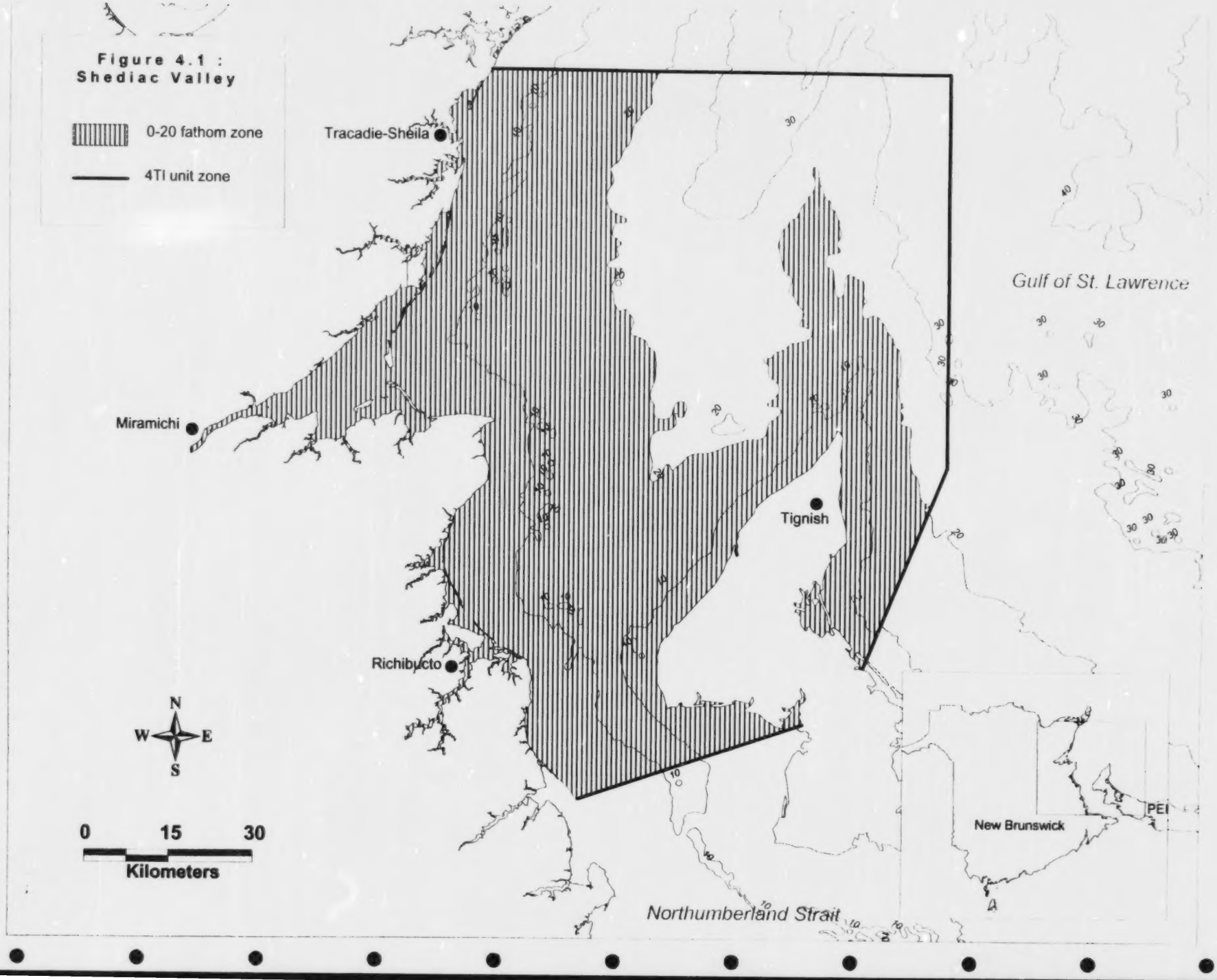


Figure 4.1 :
Shediac Valley
0-20 fathom zone
4TI unit zone
Tracadie-Sheila
Miramichi
Tignish
Richibucto
Gulf of St. Lawrence
New Brunswick
PEI
Northumberland Strait
N
W
E
S
0
15
30
Kilometers

in Miramichi and Escuminac (3.3.3) and high spat and sea scallop concentrations in the Valley (3.4.8).

4.3 Socio-economic synthesis

The New Brunswick economy largely depends on its natural resources: forests, mines and fisheries. The essential habitats studied in this report are found in three separate economic areas: Chaleur Bay, Miramichi Bay and the Northumberland Strait. Several small communities and a few «major» urban centres are found in the area. These communities depend on natural resources and, in many cases, have higher unemployment rates than elsewhere in the province.

The western part of Chaleur Bay is characterised by the presence of several industrial centres; there is Bathurst, Belledune and Dalhousie, where mining, paper mills, a smelter, thermal plant, etc. are found. These three industrial centres are among the biggest employers in this part of the province.

East of the bay, i.e. the area east of Bathurst to the Lamèque and Miscou islands, the economy largely depends on the fishing industry and fish plants. In this sector, characterised by a high unemployment rate and a large number of seasonal workers, the economic fluctuations are largely related to the state of the fish stocks. The area has experienced, and continues to experience, difficult periods since the crash of ground fish stocks in the 1980's and the subsequent closure of the cod fishery.

Miramichi Bay is also a major "industrial centre" with its paper mills, its ports, its thermal plants, etc. The forest industry is one of the largest employers in the area and contributes to its economic development through a large number of pulp and paper mills. Also, recreational fishing plays an important role in the economy of the region.

As for the Northumberland Strait, several communities, including Escuminac, Pointe-Sapin, Baie-St-Anne, St-Édouard-de-Kent, Cap-Pelé, etc. depend on the fishing industry for their survival. The most important fisheries in this sector are herring, scallop and lobster. Tourism is also important in this part of the province, but ranks second to the fisheries.

As mentioned in the first part of this report, there are over 5600 fishers in eastern New Brunswick who contribute about $120 million (1999) to the economy each year. In the study region, inshore fishers make up 90% of the total, with economic benefits representing 70% of the volume of landings. These landings represent 60% of the total value of the fishery in the region (data vary from year to year

according to demand and markets). The lobster fishery alone is worth $60 million a year (1999).

5. CONCLUSION

The review of essential habitats on the east coast of New Brunswick identified 34 major species habitat associations described in detailed fact sheets and about 50 other habitats distributed on some 41 maps attached to this document.

This review is not exhaustive, since the level of available information varies considerably, both spatially and according to species. However, it is representative of what is generally known about these aquatic resources. It provides an overview that may be useful for habitat protection, management, resource allocation or for the establishment of a new status (e.g. Marine Protected Area), or new management methods (e.g. integrated, ecosystem or coastal management).

The sum total of information gathered led to the identification of 6 essential habitats that receive a high number of references in fact sheets and tables. However, the frequency of mentions does not reflect the relative importance of these habitats, but rather the amount of information available.

The essential habitats are, in order of priority, the Miramichi watershed, Miscou Bank, the Kouchibouguac and Richibucto areas, as well as Cape Tormentine and Baie Verte. The Miramichi River watershed, a very productive well-documented environment, contains the largest, if not the only, known striped bass spawning ground in the southern Gulf.

Nine unique habitats or particularly important habitats for life stages (spawning, nursery, etc.) of associated wildlife species were also identified. As with previously mentioned habitats, this selection cannot be considered as a definitive list of the most important habitats, since it is highly dependent on the quantity of information available, but it does indicate that these habitats are significant for the species concerned. They include the western part of Chaleur Bay, the Windsor and MacGregor Malbays, Miscou Bank, Shippagan Bay, Bradelle and Orphan banks, Shediac Valley, the Miramichi watershed, the outer Miramichi Bay (between the barrier islands and Point Escuminac), and Baie Verte.

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APPENDIX A

Supplementary species habitat
considered as potential essential habitats,
but less documented

Appendix A. Supplementary species habitat considered as potential essential habitats, but less documented

American eel

Little data available for eastern NB. Most of the available information relates to the Miramichi watershed, which has been more intensively studied. The species is nevertheless likely to be present in all the accessible rivers.

Zone 3 - Migration route in the Miramichi river and the downstream portion of its two branches [A1, A3, A4] (Figure A3.2.16). The upstream boundary of the habitat is the approximate upstream limit of the salt wedge, this limit is only known for the northwest branch of the river [A5, A6]. The downstream limit of this habitat could extend to the lower limit of the estuary. The species uses growing habitats further upstream in fresh water.

American shad

Little data available for eastern NB. Most of the available information relates to the Miramichi watershed, which has been more intensively studied. The species is nevertheless likely to be present in all the accessible rivers.

Zone 3 - Migration route in the Miramichi River and the downstream portion of its two branches [A1, A3] (Figure A3.2.16). The upstream boundary of the site is the approximate upstream limit of the salt wedge, this limit is only known for the northwest branch of the river [A5, A6]. The downstream limit of this habitat could extend to the lower limit of the estuary. The species spawns further upstream in fresh water.

American oyster

Zone 3 – A very productive marsh in eastern New Brunswick, at the mouth of Oyster River, in Miramichi Bay[A29,A34] (Figure A3.4.23). Habitat boundaries are not well defined. Most of the resource is found at depths of less than 3 fathoms (5 m)[A35]. Relatively new habitat, created by the temporary closure of the mouth of the river around 1961[A34].

Aquatic birds

Little precise or exhaustive data available for eastern NB. A few major colonies are known, often as a result of detailed studies, but colonies are present everywhere along the coast.

Zone 1- Murre, heron, eider, scoter and Harlequin duck colonies on Heron Island and Great blue heron on Caraquet Island [A29] (Figure A3.5.2).

Zone 3 - Colonies: scoter, black duck, Harlequin duck, loons, northern gannet, common eider, oldsquaw, gulls, black-legged kittiwake, murres, dovekie and piping plover in the MacGregor and Windsor Malbays or elsewhere on Miscou Island[A29] (Figure A3.5.3); several salt marsh species south of Shippagan [A29] (Figure A3.5.2) and in Tabusintac (A3.5.4); several species on the barrier islands at Miramichi, as well as the common tern and the piping plover on the Kouchibouguac bars (Figure A3.5.4); and finally the great blue heron on Île au Vin in Miramichi Bay [A29] (Figure A3.5 4).

Zone 2 - Colonies along the Richibucto barrier islands [A29] (Figure A3.5.4).

Atlantic cod

Zone 1 - Nursery in Chaleur Bay [A8, A20] (Figure A3.2.24), where juveniles are abundant [A22, A23]. The site boundaries are not well defined. Third largest habitat of interest in the Gulf after Shediac Valley and north of the Magdalen Islands [A24, A25]. Juveniles are generally found at depths varying from 12.5 to 43.5 fathoms (20 and 70 m) [A26], but for younger ones (< 3 years) [A23] are at depths of less than 31 fathoms (50 m).

Atlantic halibut

Zone 3 – Adult concentration zone on Miscou Bank[A20] (Figure A3.2.19). As determined by sentinel fisheries, site boundaries take in depths of 15-20 fathoms (24-32 m). This site is one of the only locations where catches by unit of effort (CPUE) are relatively high for this species in shallow waters[A20].

Atlantic herring

Zone 1 - Fall spawning ground in Nepisiguit Bay, in Caraquet and west of Miscou Island [A8] (Figure A3.2.20). The fall spawning grounds are generally 2 to 10 fathoms deep (3.2 to 16 m)[A10].

Zone 3 - Nursery in Miramichi Bay [A2, A3, A4] (Figure A3.2.17). The boundaries of the habitat are not well defined. Secondary habitat after the ones in Chaleur Bay, Shediac Valley and Baie Verte [A11, A12, A13, A14]. The young aged 0+ are at depths of less than 15.5 fathoms (25 m) [A12, A14], while the young aged 1+ and 2+ are at depths between 12.5 and 31 fathoms (20 and 50 m) [A11, A14] and the aged 3+ are with the adults at depths greater than 31 fathoms (50 m) [A11, A13].

Zone 3 - Spring spawning ground in Kouchibouguac [A8] (Figure A3.2.21). The spring spawning grounds are generally at depths of less than 2 fathoms (3.2 m) [A10].

Zone 2 - Spring spawning grounds in Richibucto [A8] (Figure A3.2.21), Bouctouche, Cocagne and Shediac [A8] (Figure A3.2.22), as well as in Cape Tormentine and Baie Verte [A8] (Figure A3.2.21). The spring spawning grounds are generally at depths of less than 2 fathoms (3.2 m)[A10].

Zone 2 - Fall spawning ground in Baie Verte (Figure A3.2.22). This spawning ground is probably minor since it generates low landings. The fall spawning grounds are generally at depths of between 2 and 10 fathoms (3.2-16 m) [A10].

Atlantic mackerel

Zone 1 - Spawning ground in Chaleur Bay [A8, A17] (Figure A3.2.23). Second major spawning ground after the ones in Bradelle and Orphan banks [A17].

Zone 3 - Nursery in Miramichi Bay [A2, A3] (Figure A3.2.17). The boundaries of the habitat are not well defined.

Atlantic salmon

This species is found in the larger rivers of the province. However, because spawning grounds are in fresh water, they cannot be included in an integrated coastal management plan. Obviously, the estuaries of all these rivers are migration routes to access the spawning grounds. It was decided that only one would be presented as an example (the one with the most available information).

Zone 3 - Migration route in the Miramichi River and the downstream portion of its two branches [A1,A2, A3, A4] (Figure A3.2.16). The upstream boundary of the habitat is the approximate upstream limit of the salt wedge, this limit is available only for the northwest branch of the river [A5, A6]. Downstream, the limit could extend to the entire estuary. The species spawns further upstream in fresh water.

Atlantic tomcod

Little data available for eastern NB. Most of the available information relates to the Miramichi watershed, which has been more intensively studied. The species is nevertheless likely to migrate seasonally in all the accessible rivers.

Zone 3 - Migration route in the Miramichi River and the downstream portion of its two branches [A1,A2, A3, A4] (Figure A3.2.16). The upstream boundary of the habitat is

the approximate upstream limit of the salt wedge, which limit is known only for the northwest branch of the river [A5, A6]. The downstream limit of this habitat could extend to the lower limit of the estuary. The species spawns further upstream in fresh water.

Zone 3 - Nursery in Miramichi Bay [A2, A3, A4] (Figure A3.2.17). The boundaries of the site are general.

Zone 3 - Overwintering area in Miramichi River [A9] (Figure A3.2.18). The boundary of the habitat is limited to the approximate limit of the salt wedge [A5, A6] and the limit of the study area [A9].

Blueback herring

Little data available for eastern NB. Most of the available information relates to the Miramichi watershed, which has been more intensively studied. The species is nevertheless likely to be present in all the accessible rivers.

Zone 3 - Migration route in the Miramichi river and the downstream portion of its two branches [A1,A2, A3, A4] (Figure A3.2.14). The upstream boundary of the habitat is the approximate upstream limit of the salt wedge, this limit is known only for the northwest branch of the river [A5, A6]. The downstream limit may correspond to the downstream limit of the estuary. The species spawns further upstream in fresh water.

Zone 3 - Nursery in Miramichi Bay [A2, A3, A4] (Figure A3.2.15). The boundaries of this habitat are not well defined.

Blue mussel

Little data available for eastern NB. Two main concentration areas suitable for aquaculture are known [A16], but the species is nevertheless present everywhere along the coast.

Zone 1 - Concentration in the bays located on each side of the channel in the Shippagan Bay [A16, A27] (Figure A3.4.13). The resource is nevertheless present along the shores.

Zone 3 - Concentration in Miramichi Bay [A16] (Figure A3.4.14). The downstream limit of this habitat corresponds to the physical limits of the estuary, i.e. the barrier islands. Higher concentration areas were identified about twenty years ago [A4].

Sea scallop

Spat concentrations were described in fact sheets (3.4.6 to 3.4.8), these concentrations of adults were identified by commercial fishers.

Zone 1 - Concentration west of Miscou Island [A8] (Figure A3.4.20)

Zone 3 - Concentration east of Miscou Island [A8] (Figure A3.4.20)

Zone 2 - Concentration between Bouctouche and Murray Beach [A8] (Figure A3.4.21).

Gaspereau

Little data available for the species. Most of the available information relates to the Miramichi watershed, which has been more intensively studied. The species is nevertheless likely to be present in all the accessible rivers.

Zone 3 - Migration route in the Miramichi River and the downstream portion of its two branches [A1,A2, A3, A4] (Figure A3.2.16). The upstream boundary of this habitat is the approximate upstream limit of the salt wedge, this limit is available only for the northwest branch of the river [A5, A6]. Downstream, the limit could extend to the entire estuary. The species spawns further upstream in fresh water.

Zone 3 - Nursery in Miramichi Bay [A2, A3, A4] (Figure A3.2.17). The boundaries of the habitat are not well defined.

Gray seal

Little specific data are available for this species. It is likely to be present in areas other than the ones identified. For example, there are small concentrations in Point Escuminac and on the barrier islands of Miramichi Bay [A18].

Zone 3 - Known haulout in Kouchibouguac [A18] (Figure A3.5.5).

Zone 2 and 3 - Concentration area between Miramichi and Richibucto [A18] (Figure A3.5.6). It is mainly the territory covered by the haulout population in Kouchibouguac.

Zone 2 - Concentration in Baie Verte [A18] (Figure A3.5.7), the seals coming from haulouts farther east, namely Amet Island.

Green sea urchin

Little detailed or exhaustive data available for eastern NB. A few areas of concentration are known, from exploratory fishing done in 1993 [A30], and five beds of sufficient size to allow exploitation are known, but this resource is mobile and is likely to be present wherever aquatic vegetation (kelp) is concentrated along the coast.

Zone 1 - Concentration around Heron Island, west of Lamèque Island and east of Shippagan Bay[A30] (Figure A3.4.18)

Zone 3 - Concentration east of Lamèque Island [A30] (Figure A3.4.18)

Zone 1 - Concentration around Point Escuminac [A30] (Figure A3.4.19).

Harbour porpoise

Little specific data are available for this species. It is likely to be present in areas other than the ones identified.

Zone 3 - Concentration on Miscou Bank [A18, A19] (Figure A3.5.1).

Harbour seal

Little data are available for this species. It is likely to be present in other areas than the ones identified. There are small concentrations in Point Escuminac and on the barrier islands of Miramichi Bay [A18].

Zone 3 - Known haulout in Kouchibouguac [A18] (Figure A3.5.5).

Quahog

Little specific or detailed data available for eastern NB. A few concentration areas are known, but this resource is likely to be present everywhere along the coast. The resource is generally found at shallow depths, between the intertidal and sublittoral coast limits [A32].

Zone 2 - Concentration in Bouctouche, Cocagne and Shemogue [A16] (Figure A3.4.22).

Rainbow smelt

Little data available for eastern NB. Most of the available information relates to the Miramichi watershed, which has been more intensively studied. The species is nevertheless likely to be present in all the accessible rivers.

Zone 3 - Migration route in the Miramichi River and the downstream portion of its two branches[A1,A2, A3, A4] (Figure A3.2.16). The upstream boundary of this habitat is the approximate upstream limit of the salt wedge, this limit is only known for the northwest branch of the river [A5, A6]. Downstream, the limit could extend to the entire estuary. The species spawns further upstream in fresh water.

Zone 3 - Nursery in Miramichi Bay [A2, A3, A4] (Figure A3.2.17). The boundaries of this habitat are not well defined.

Zone 3 - Overwintering area in Miramichi River [A9] (Figure A3.2.18). The boundary of this habitat corresponds to the approximate limit of the salt wedge [A5, A6] and the limit of the study area [A9].

Rock crab

Zone 3 - Ripe female concentration south of Point Escuminac [A8] (Figure A3.3.6).

Zone 2 - Ripe female concentration in Bouctouche, Cap-Pelé, Shemogue, Murray Beach, Cape Tormentine and Baie Verte [A8] (Figure A3.3.7).

Sand lance

Little data available for eastern NB. Most of the available information is for the Miramichi watershed, which has been more intensively studied. The species is nevertheless likely to be present in all the accessible rivers.

Zone 3 - Nursery in Miramichi Bay [A2, A3] (Figure A3.2.17). The boundaries of the habitat are not well defined.

Soft shell clam

Little data available for eastern NB. Four main concentration areas are known [A16], but the species is nevertheless present everywhere along the coast. The resource is generally found at depths of less than 0.6 fathoms (1 m) [A16].

Zone 1 - Concentrations around Heron Island [A16] (Figure A3.4.16).

Zone 3 - Concentration in Miramichi Bay [A16] (Figure A3.4.17). The downstream limit of this habitat is defined by the physical limits of the estuary, the barrier islands. Higher concentration areas were identified about twenty years ago [A4].

Zone 2 - Concentration in Richibucto and Bouctouche [A16] (Figure A3.4.18).

Smooth flounder

Zone 3 - Nursery in Miramichi Bay [A2, A3, A4] (Figure A3.2.17). The boundaries of this habitat are not well defined.

Zone 3 - Spawning ground in Miramichi Bay [A3, A9] (Figure A3.2.25). The boundaries of the site are not well defined.

Zone 3 - Overwintering area in Miramichi Bay [A3, A9] (Figure A3.2.26). The boundaries of the site are not well defined.

Striped bass

The Miramichi River has the largest population in its brackish or salt water portions. Data available for other rivers have only confirmed that they are used for overwintering in fresh water, excluding them as essential habitats.

Zone 3 - Nursery area in Miramichi Bay [A2, A3, A4, A7, A33] (Figure A3.2.17) where larvae and young-of-the-year (0+ age) are found. The habitat boundaries are not well defined.

Surf clam

Little data available for eastern NB. Four main concentration areas are known [A16], but the species is nevertheless found everywhere along the coast. The resource is generally found at depths of less than 5 fathoms (8 m)[A16].

Zone 1 - Concentration in Caraquet [A16] (Figure A3.4.10).

Zone 3 - Concentration in Miramichi Bay [A16] (Figure A3.4.11). The habitat is bounded downstream by the physical limits of the estuary, the barrier islands. Higher concentration areas were identified about twenty years ago [A4]. High concentrations have also been observed in Kouchibouguac and Richibucto [A16] (Figure A3.4.11).

Zone 2 - Concentrations in Cape Tormentine and Baie Verte [A16] (Figure A3.4.12).

White hake

Zone 3 - Nursery in Miramichi Bay [A3] (Figure A3.2.17). The boundaries of the site are not well defined.

Winter flounder

Zone 1 – Nursery area in the bays located on each side of the channel in Shippagan Bay [A27, A31] (Figure A3.2.27). Habitat boundaries are not well defined.

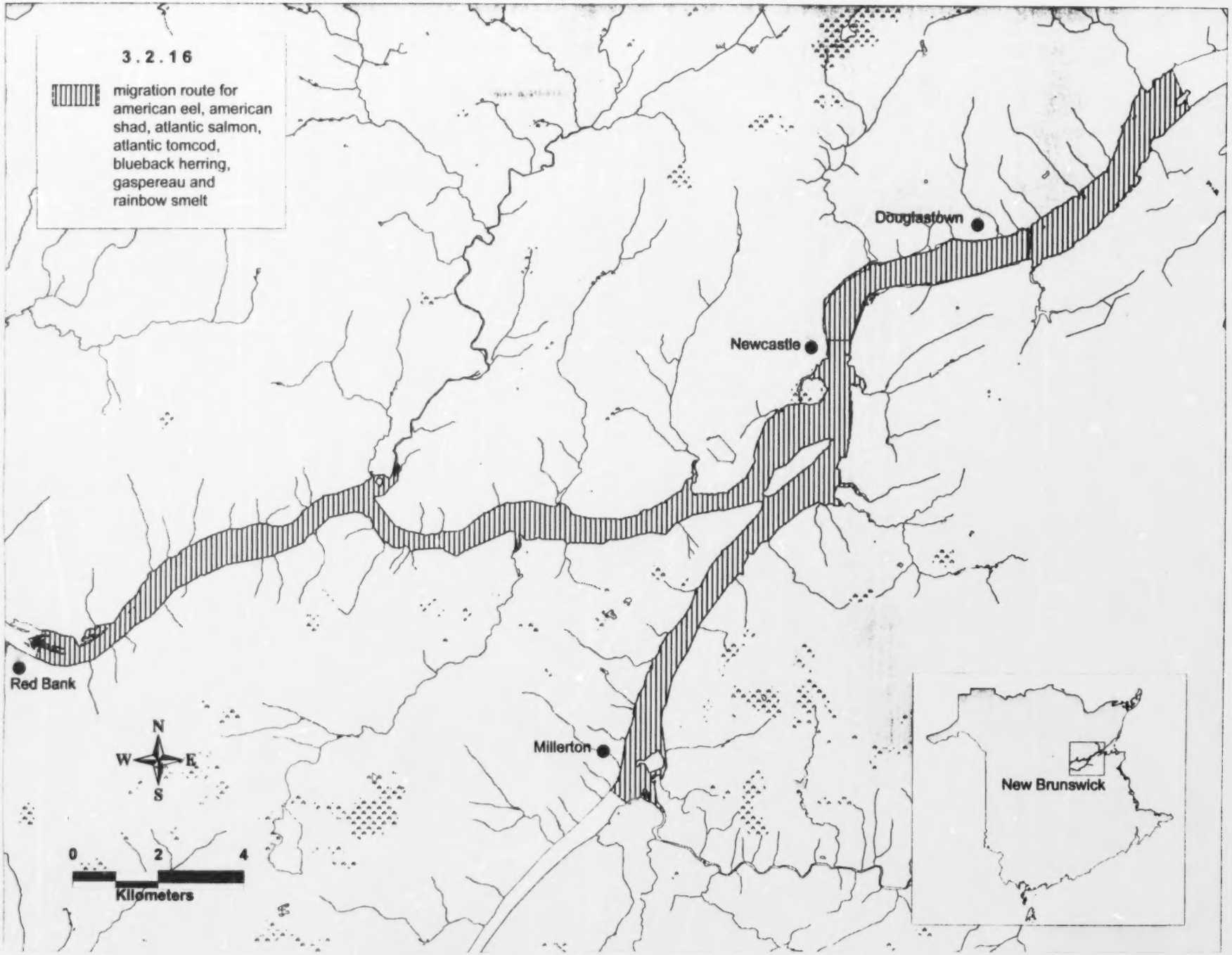
Zone 3 - Nursery in Miramichi Bay [A3, A4] (Figure A3.2.17) and immediately outside the barrier islands [A31] (Figure A3.2.26) for young of the year. The boundaries of the site are not well defined.

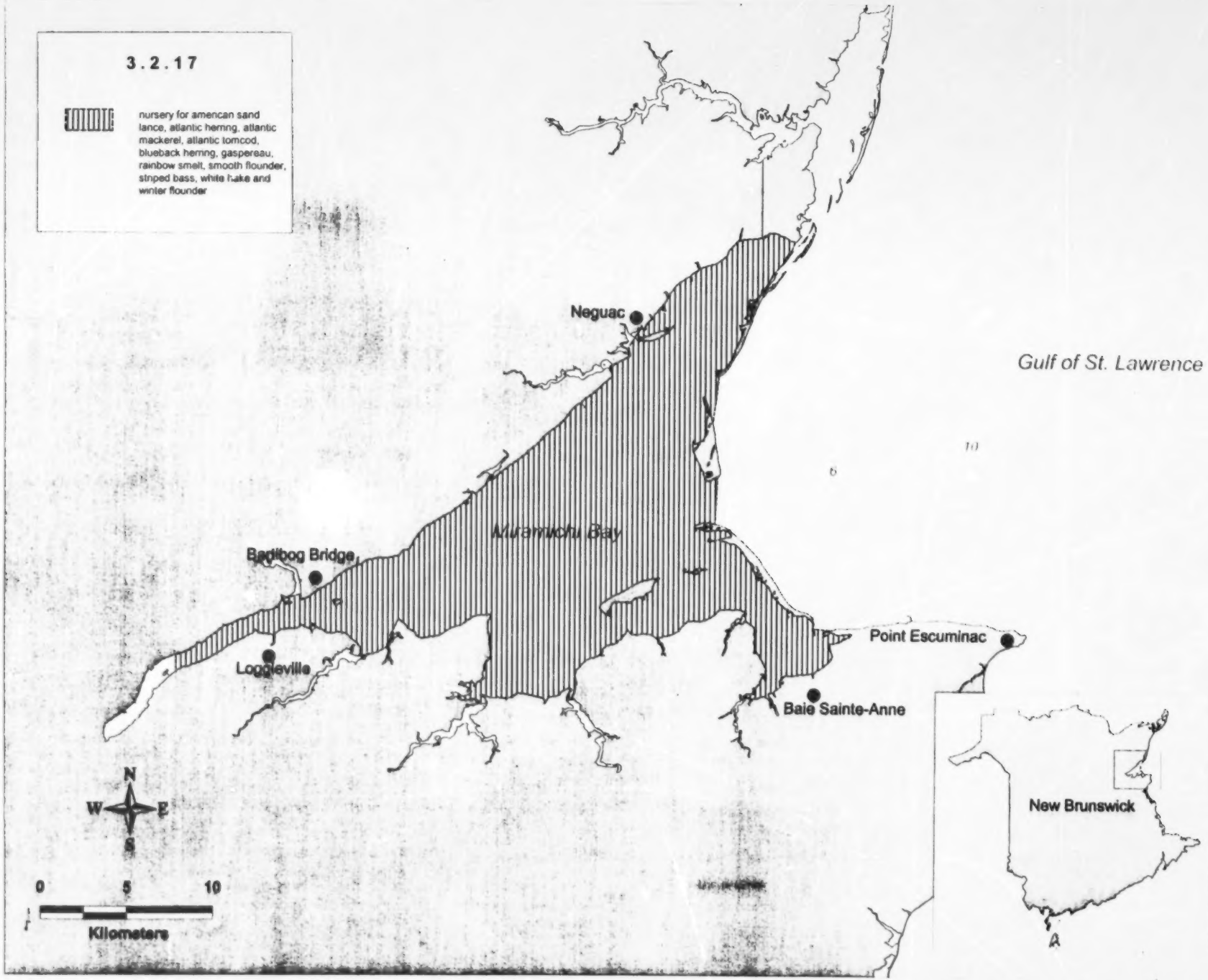
Zone 3 - Spawning ground between Miscou and Tracadie [A8] (Figure A3.2.27).

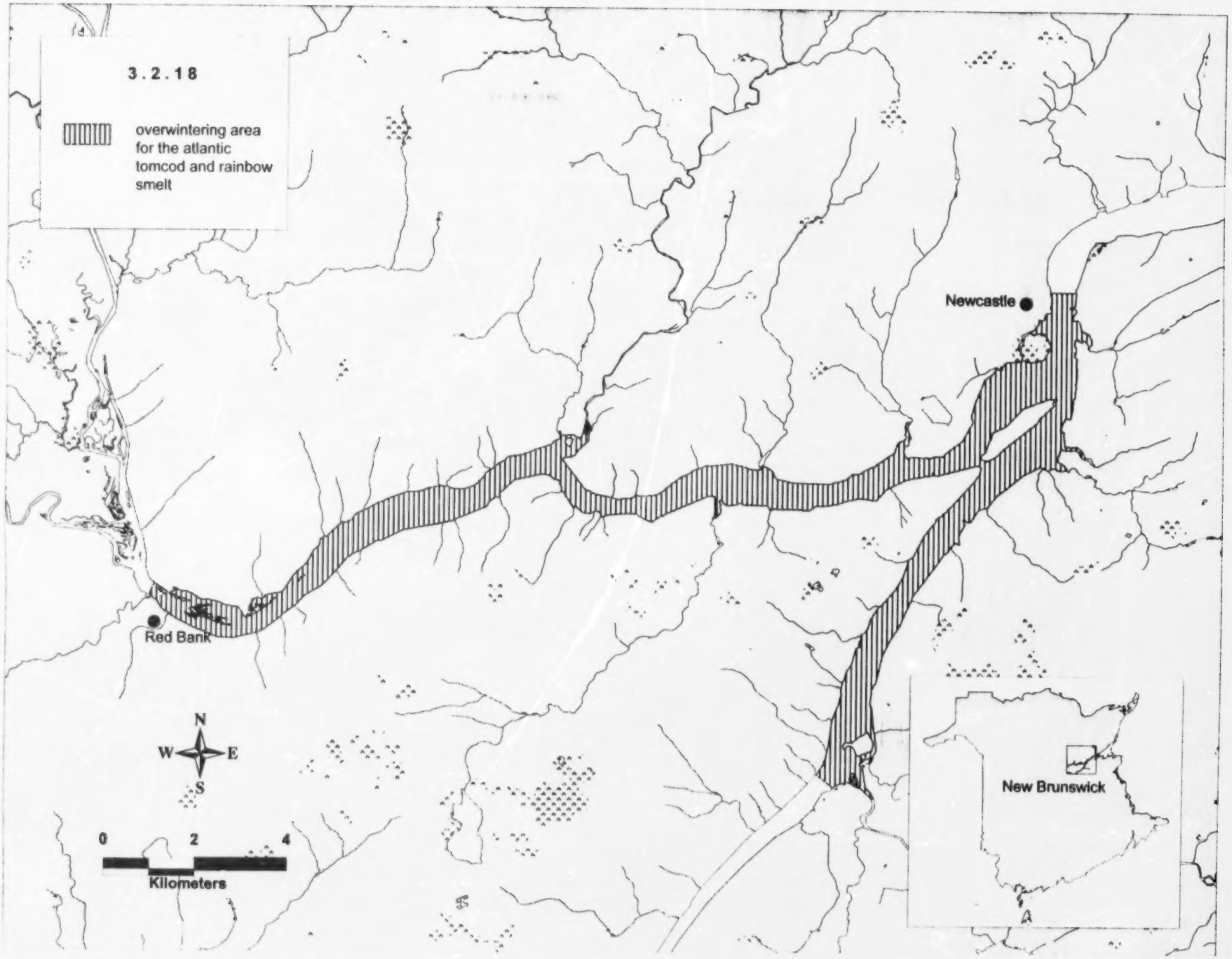
Zone 3 - Overwintering area in Miramichi Bay [A3, A9] (Figure A3.2.26). The boundaries of the site are not well defined.

References

A1 : Chaput, 1995
A2 : Locke and Courtenay, 1995
A3 : Hanson and Courtenay, 1995
A4 : Philpott, 1978
A5 : Locke et al., 1996
A2 : Locke and Courtenay, 1996
A7 : Bradford, Robichaud and Courtenay,1995
A8 : J. Lee MacNeil & Associates, 1998
A9 : Hanson and Courtenay, 1996
A10 : Claytor et al., 1998
A11 : C. LeBlanc, c.p. 1999
A12 : Dupuis et al., 1997
A13 : LeBlanc et al., 1998
A14 : LeBlanc et al., 1997
A16 : T. Landry, c.p. 1999
A17 : F. Grégoire, c.p. 1999
A18 : J-F Gosselin, c.p. 1999
A19 : Fontaine et al., 1994
A20 : G. Chouinard, c.p. 1999
A21 : Hurlbut et al., 1998
A22 : Swain, 1999
A23 : Hanson, 1996
A24 : Sinclair et al., 1998
A25 : Chouinard et al., 1991
A26 : Swain, 1993
A27 : SENPAQ, 1987
A28 : SENPAQ, 1996
A29 : E. Ferguson, c.p. 1999
A30 : Lanteigne and Lanteigne, 1993
A31 : DFO Fishery officers, c.p. 1999
A32 : DFO (northern quahog), 1996a
A33 : Robichaud-LeBlanc *et al.*, 1998
A34 : S. Courtenay, c.p. 1999


3.2.16
migration route for american eel, american shad, atlantic salmon, atlantic tomcod, blueback herring, gaspereau and rainbow smelt
Dougtastown
Newcastle
Red Bank
Millerton
N
W
E
S
0
2
4
Kilometers
New Brunswick


3.2.17
nursery for amencan sand lance, atlantic herring, atlantic mackerel, atlantic tomcod, blueback herring, gaspereau, rainbow smelt, smooth flounder, striped bass, white hake and winter flounder
Neguac
Gulf of St. Lawrence
Miramichi Bay
Badibog Bridge
Loggieville
Point Escuminac
Baie Sainte-Anne
New Brunswick
N
W
E
S
0
5
10
Kilometers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overwintering area for the atlantic tomcod and rainbow smelt
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Red Bank
N
W
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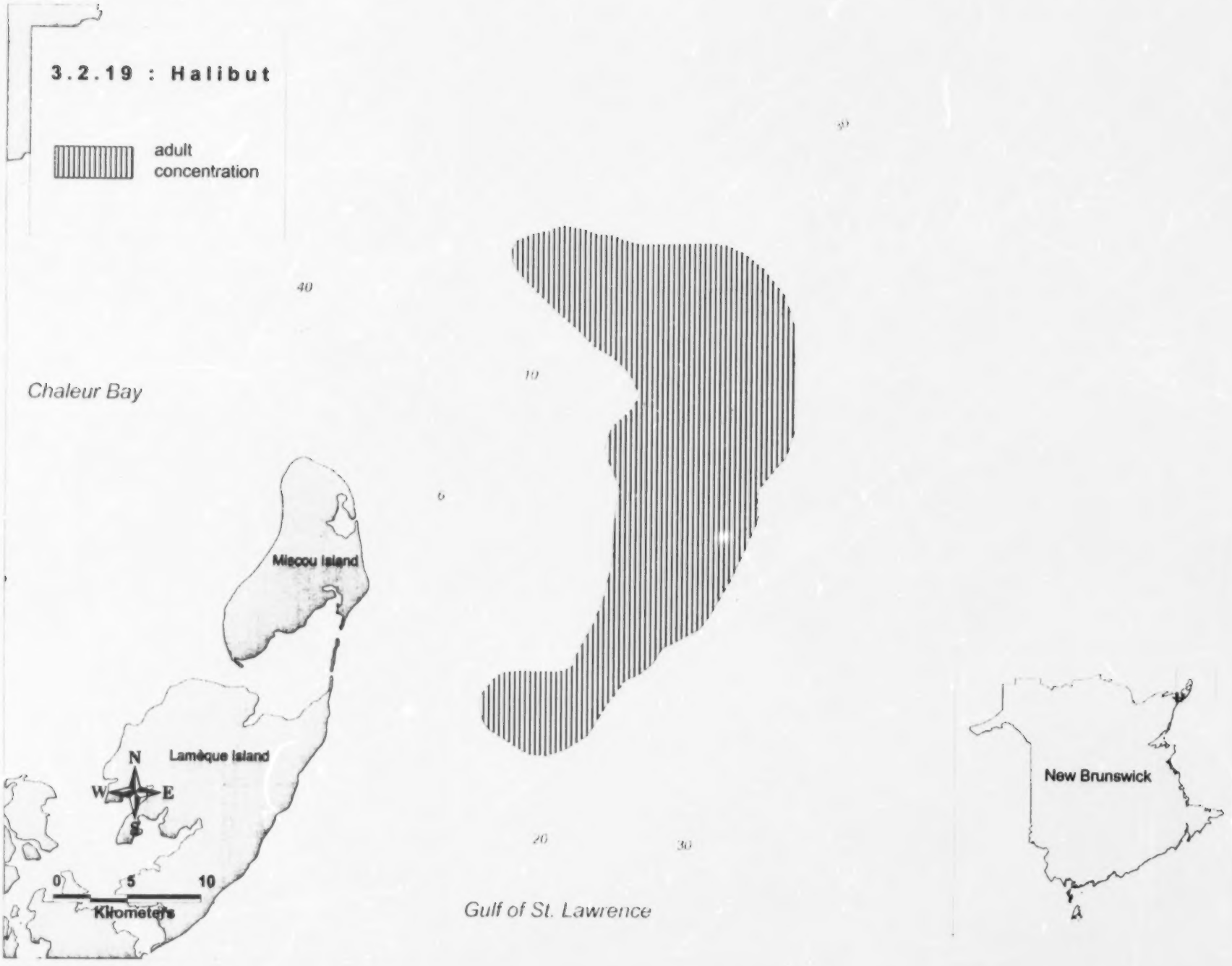
0
2
4
Kilometers
New Brunswick


3.2.19 : Halibut
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Chaleur Bay
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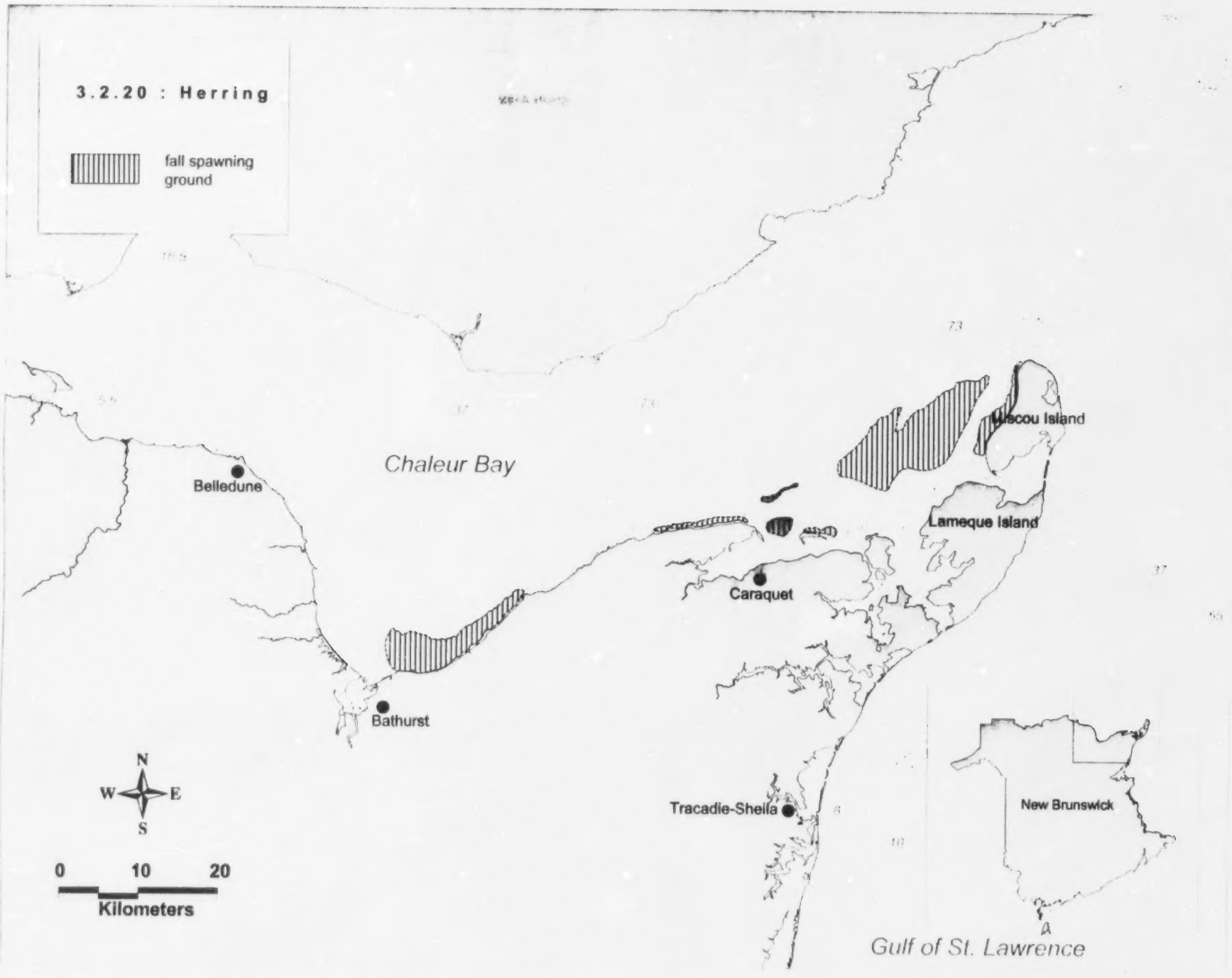
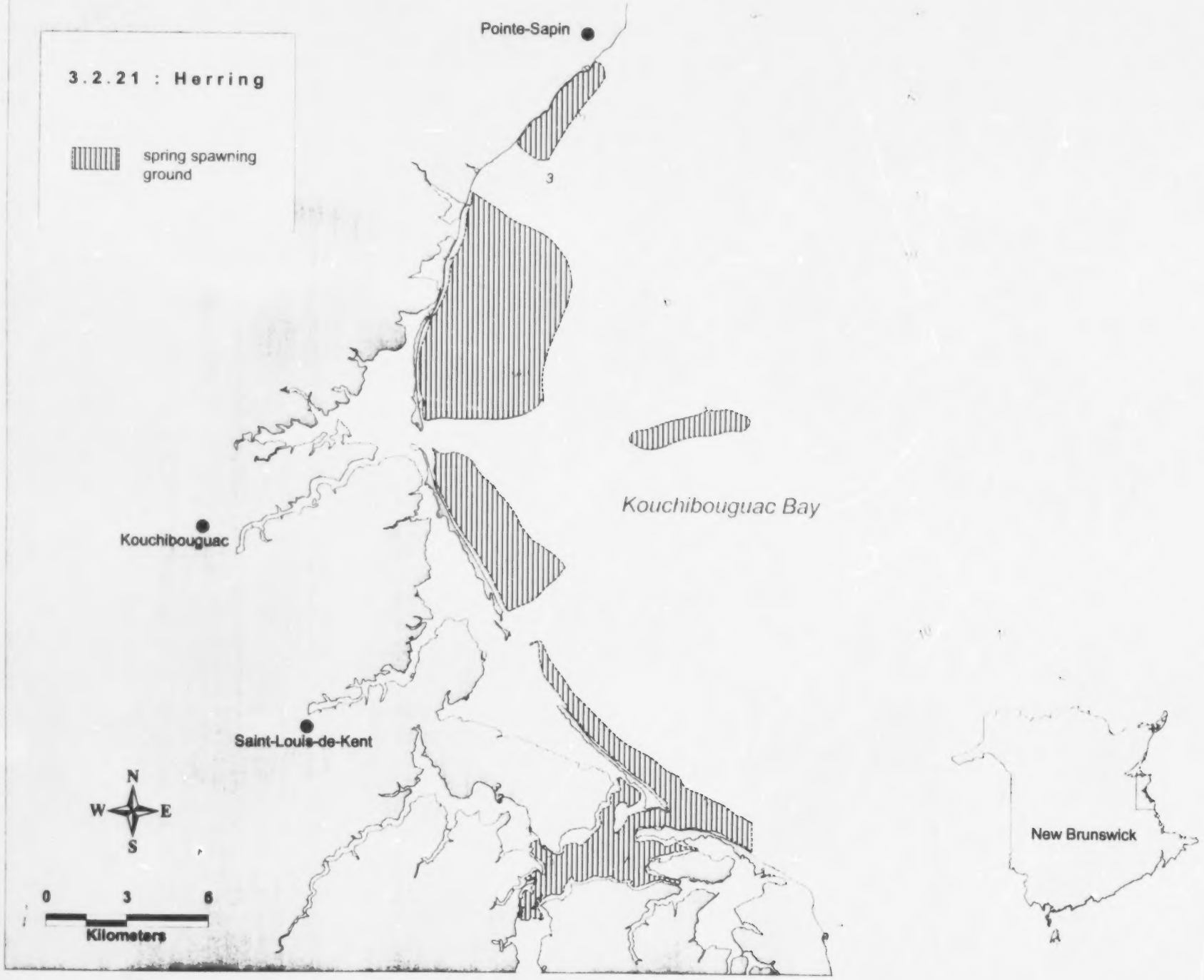
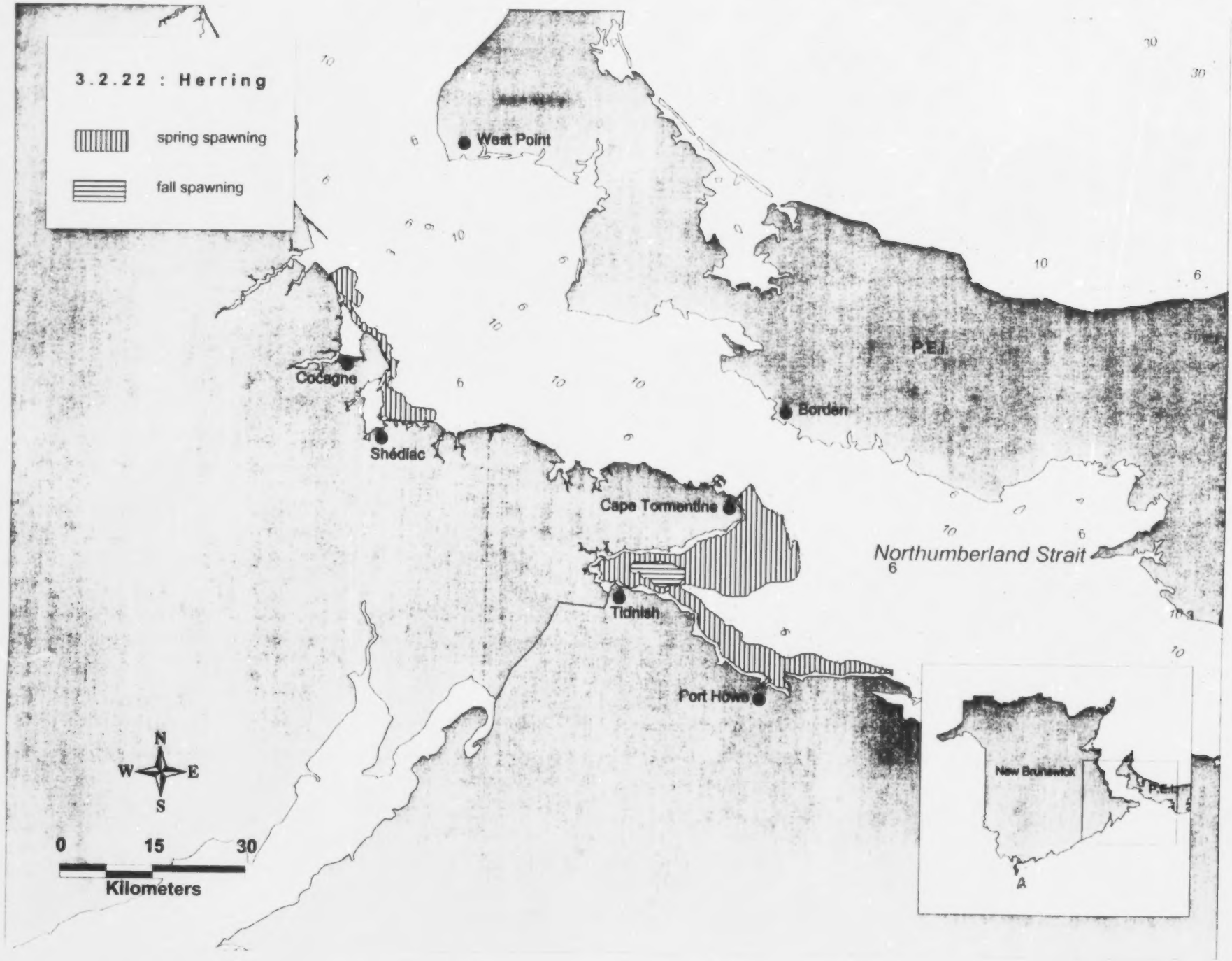
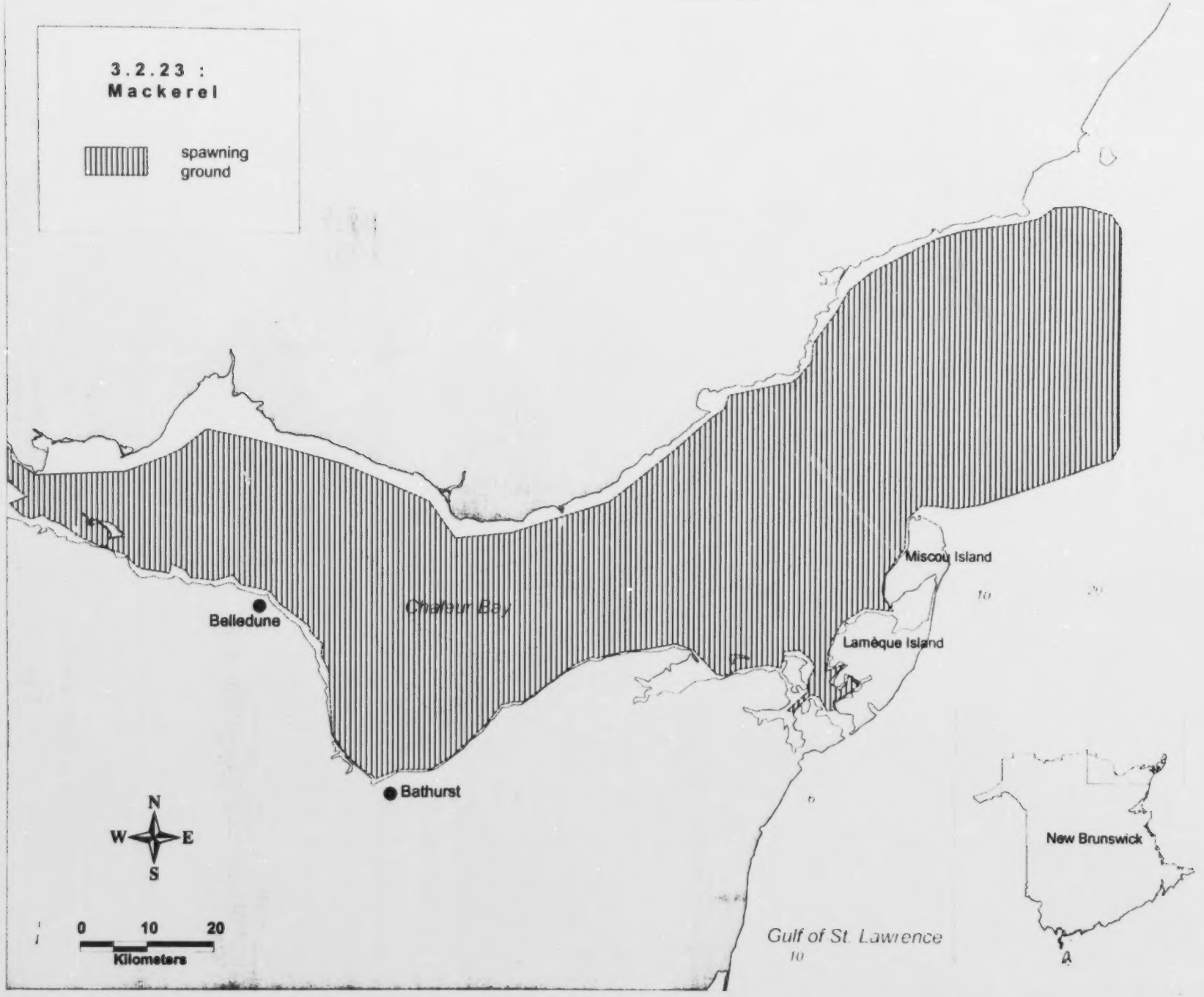
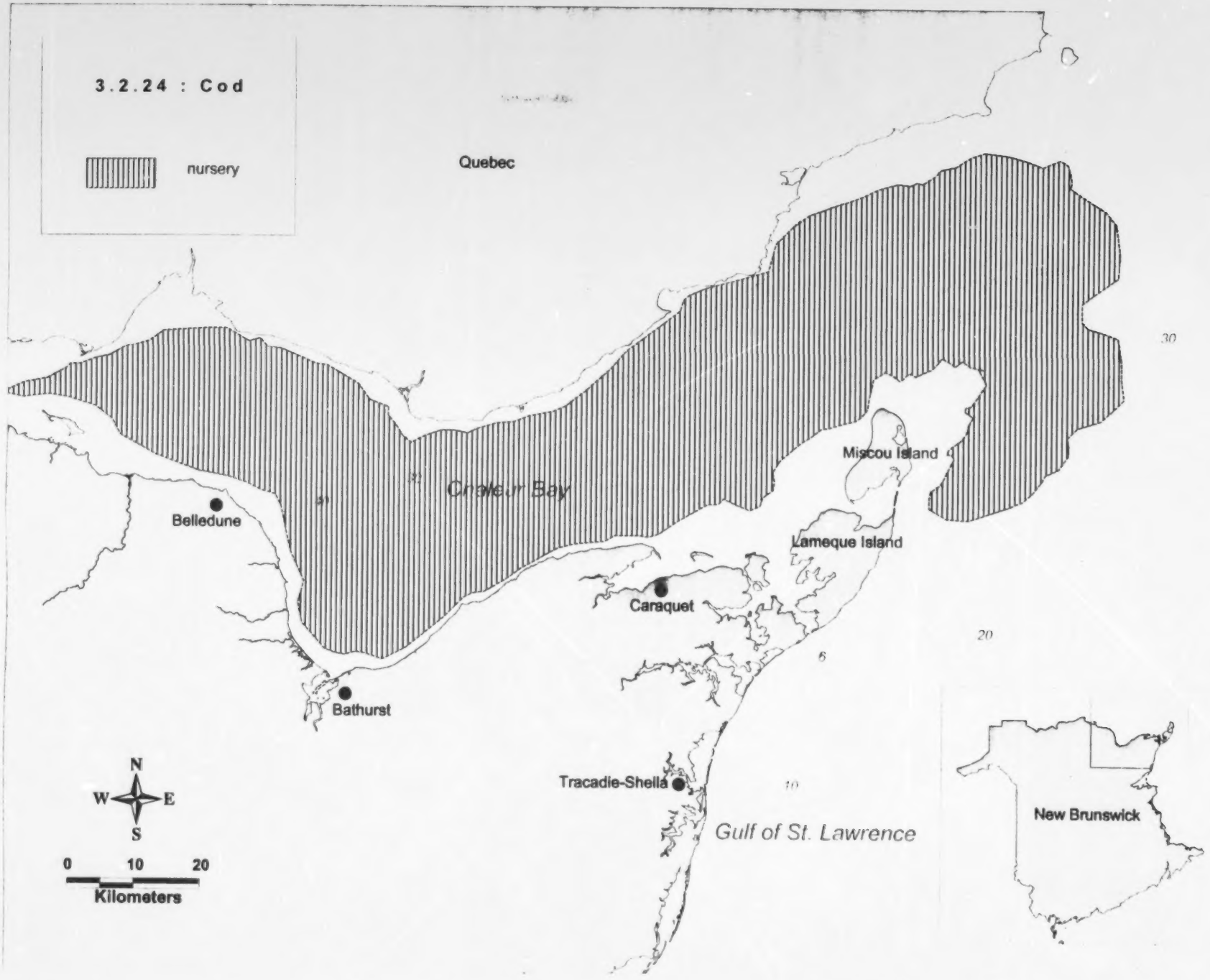
Lamèque Island
N
W
E
S
0
5
10
Kilometers
Gulf of St. Lawrence
New Brunswick


3.2.20 : Herring
fall spawning ground
Chaleur Bay
Belledune
Bathurst
Caraquet
Miscou Island
Lameque Island
Tracadie-Sheila
New Brunswick
Gulf of St. Lawrence
N
W
E
S
0
10
20
Kilometers


3.2.21 : Herring
spring spawning ground
Pointe-Sapin
3
Kouchibouguac Bay
Kouchibouguac
Saint-Louis-de-Kent
N
W
E
S
0
3
6
Kilometers
New Brunswick


3.2.22 : Herring
spring spawning
fall spawning
West Point
Cocagne
Shédiac
Cape Tormentine
Tidnish
Port Howe
Borden
P.E.I.
Northumberland Strait
N
W
E
S
0
15
30
Kilometers
New Brunswick
P.E.I.
A


3.2.23 :
Mackerel
spawning ground
Miscou Island
Chaleur Bay
Belledune
Lamèque Island
Bathurst
N
W
E
S
0
10
20
Kilometers
Gulf of St. Lawrence
New Brunswick


3.2.24 : Cod
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Bathurst
Miscou Island
Lameque Island
Caraquet
Tracadie-Sheila
Gulf of St. Lawrence
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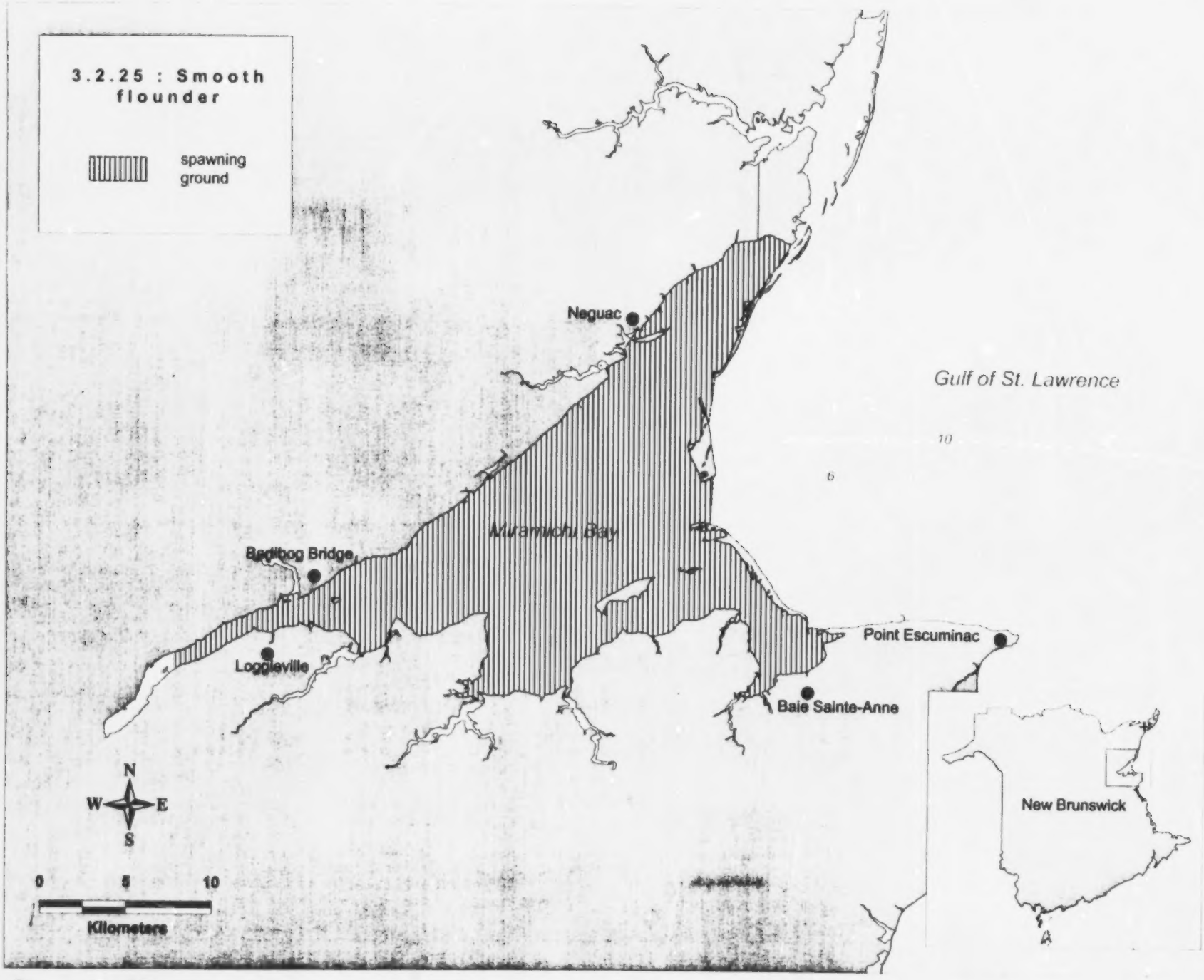
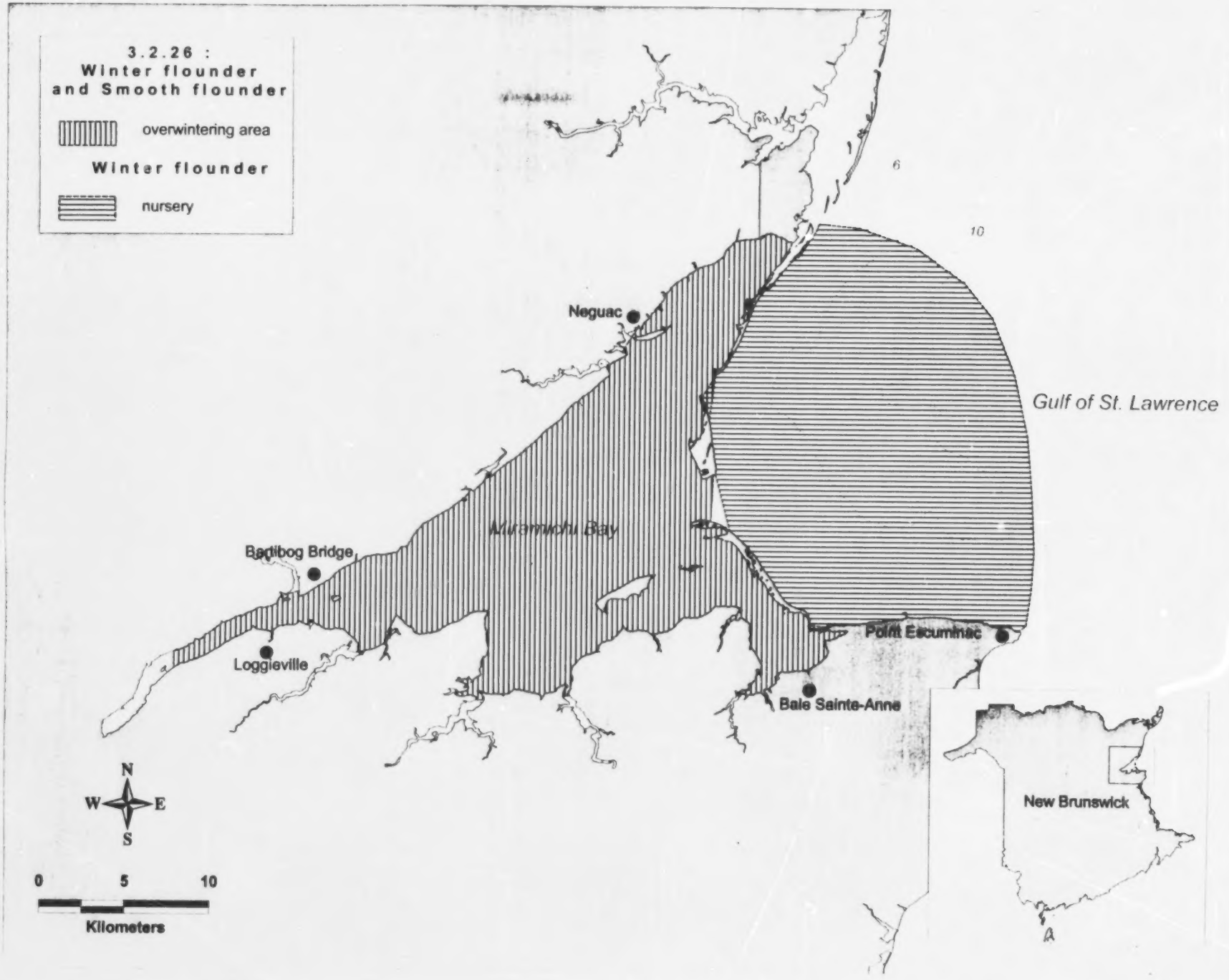
Kilometers


3.2.25 : Smooth flounder
spawning ground
Neguac
Gulf of St. Lawrence
Miramichi Bay
Redbog Bridge
Loggieville
Point Escuminac
Baie Sainte-Anne
New Brunswick
N
W
E
S
0
5
10
Kilometers


3.2.26 :
Winter flounder
and Smooth flounder
overwintering area
Winter flounder
nursery
Neguac
Gulf of St. Lawrence
Miramichi Bay
Badibog Bridge
Loggieville
Point Escuminac
Baie Sainte-Anne
New Brunswick
N
W
E
S
0
5
10
Kilometers

3.2.27 :
Winter flounder
nursery
spawning ground
Chaleur Bay
Miscou Island
Lameque Island
Caraquet
Shippagan
Pokemouche
Tracadie-Sheila
Gulf of St. Lawrence
New Brunswick
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W
E
S
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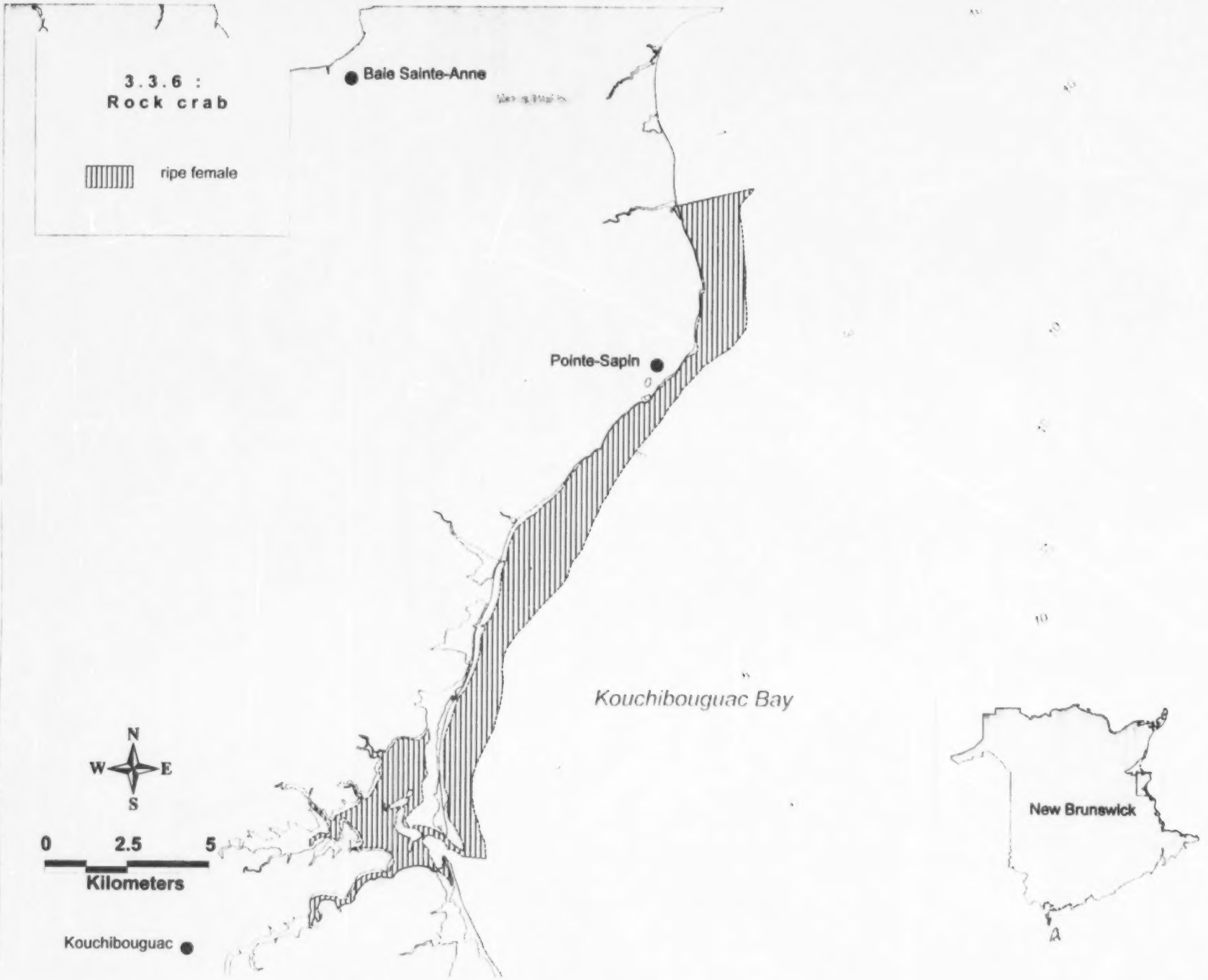
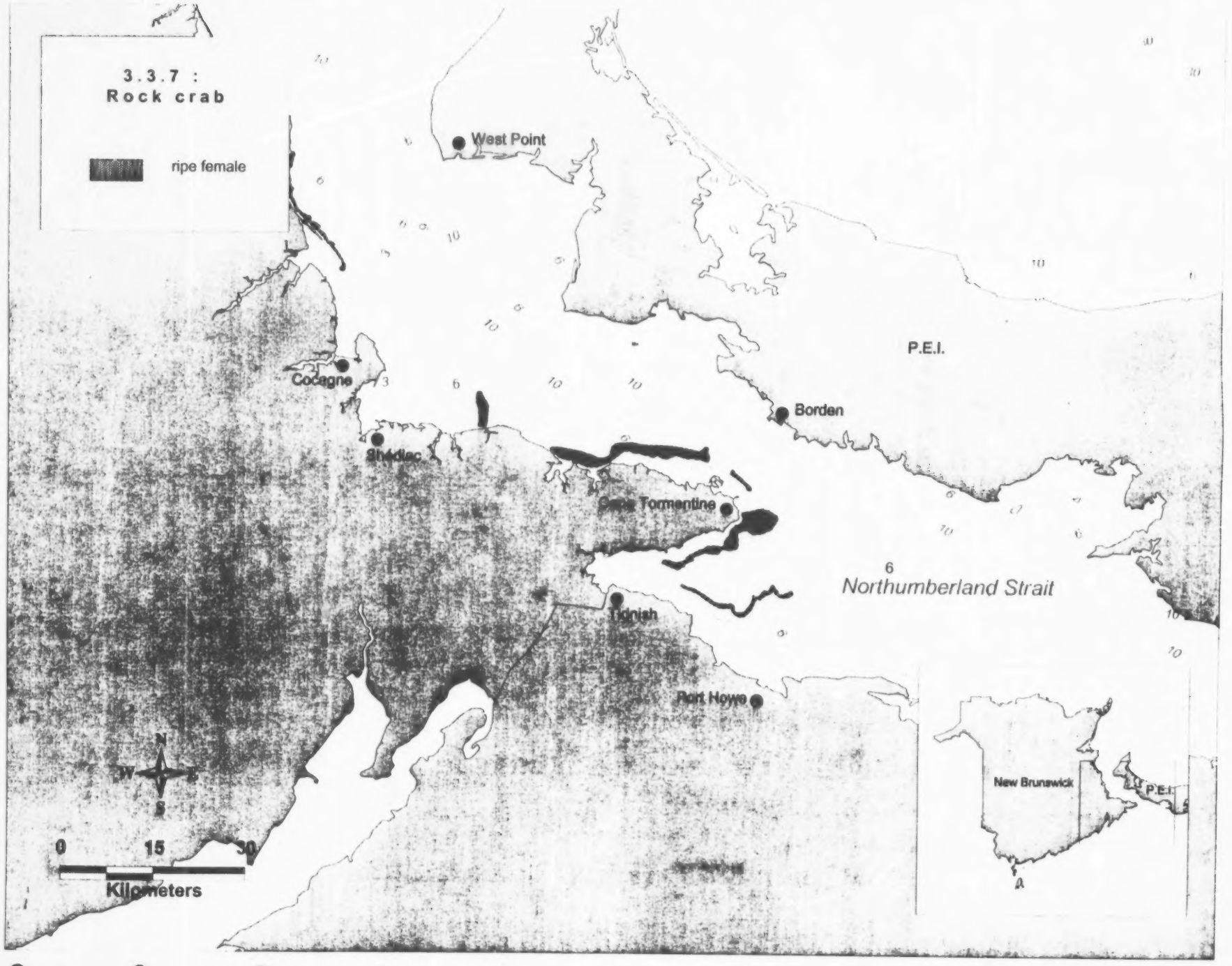
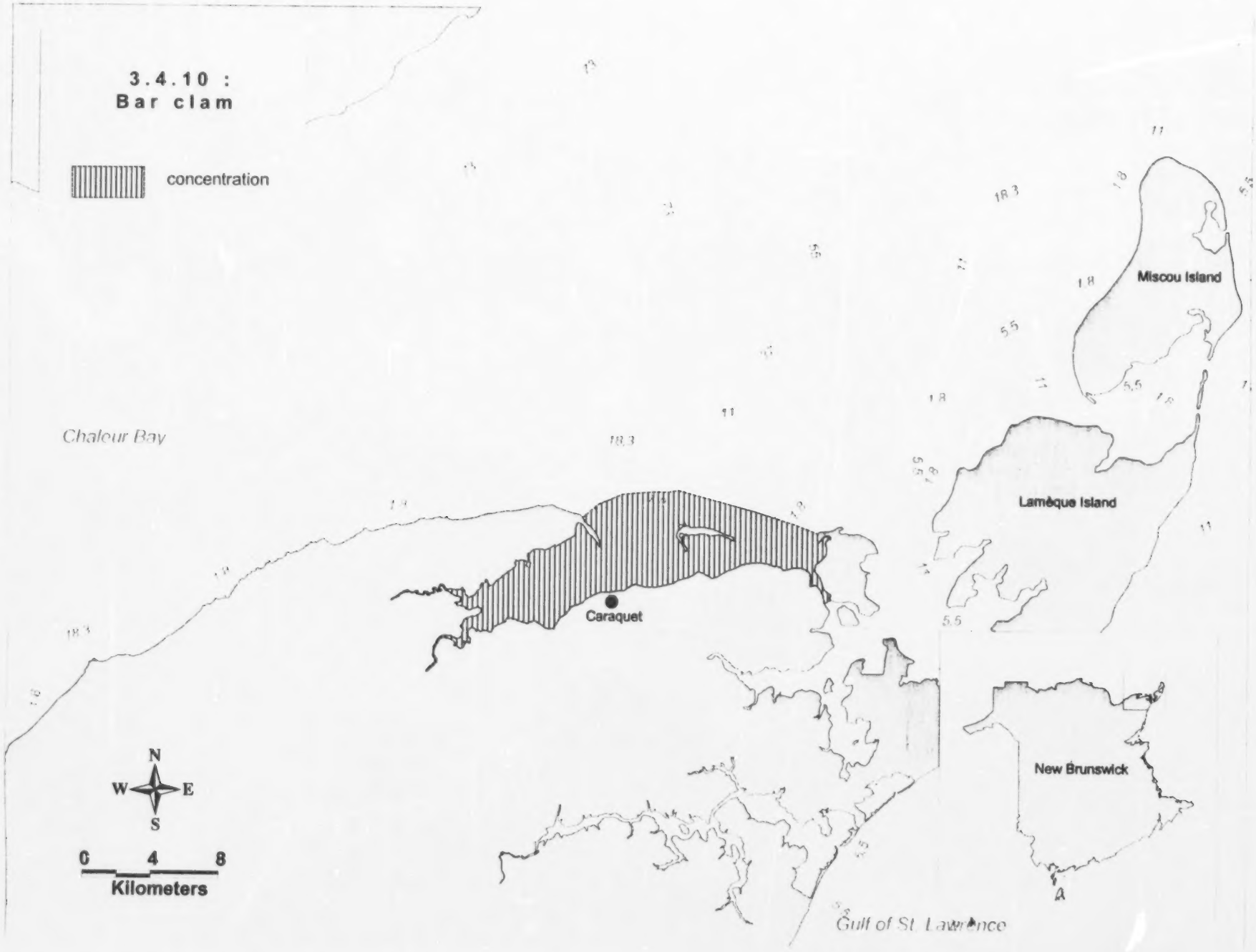
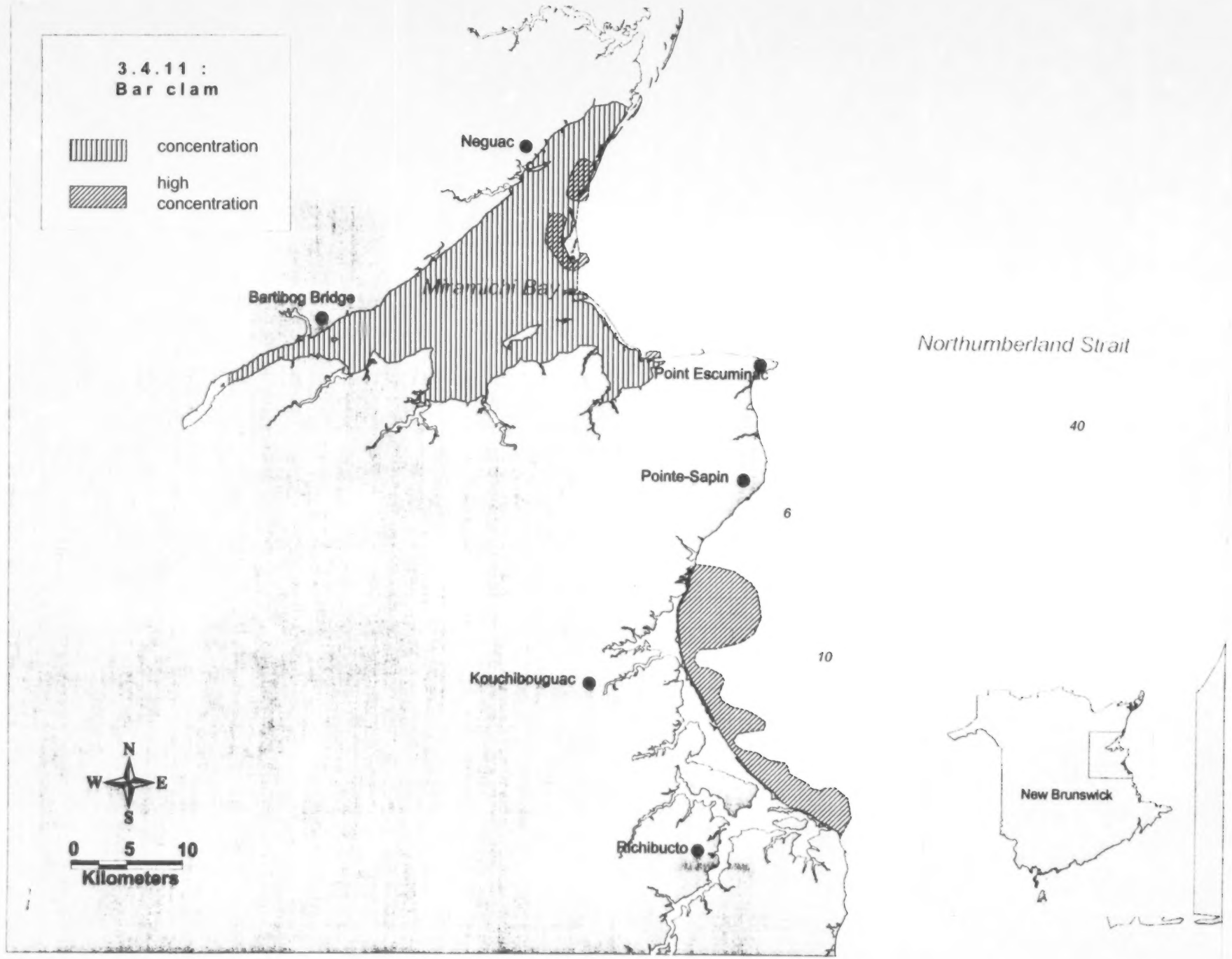
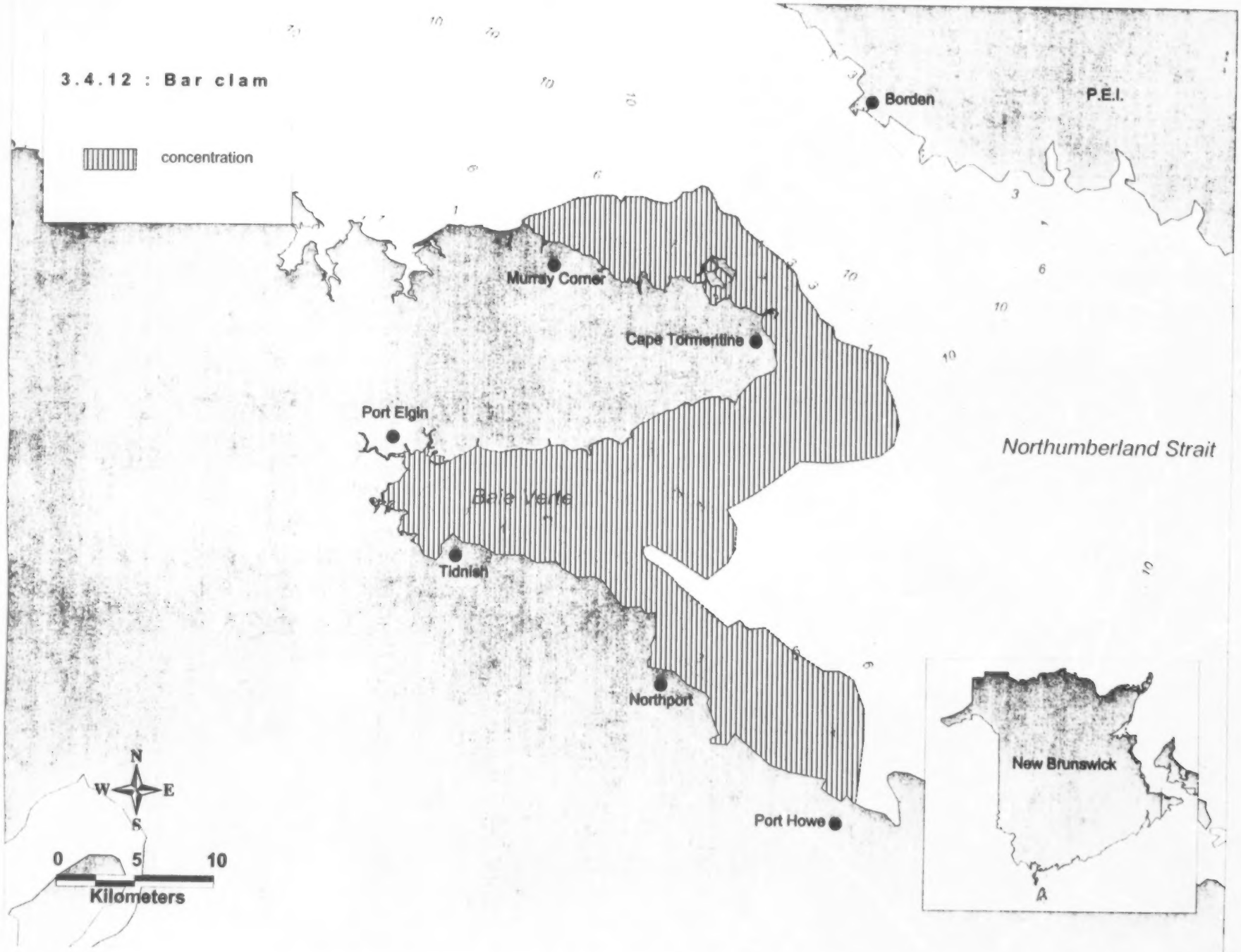
10
Kilometers


3.3.6 :
Rock crab
ripe female
Baie Sainte-Anne
Pointe-Sapin
Kouchibouguac Bay
N
W
E
S
0
2.5
5
Kilometers
Kouchibouguac
New Brunswick


3.3.7 :
Rock crab
ripe female
West Point
P.E.I.
Cocagne
Borden
Shediac
Cape Tormentine
Northumberland Strait
Tignish
Port Howe
New Brunswick
P.E.I.
N
W
E
S
0
15
30
Kilometers


3.4.10 :
Bar clam
concentration
Chaleur Bay
Caraquet
Miscou Island
Lamèque Island
New Brunswick
Gulf of St. Lawrence
N
W
E
S
0 4 8
Kilometers


3.4.11 :
Bar clam
concentration
high concentration
Neguac
Miramichi Bay
Bartibog Bridge
Point Escuminac
Northumberland Strait
40
Pointe-Sapin
6
10
Kouchibouguac
Richibucto
N
W
E
S
0 5 10
Kilometers
New Brunswick

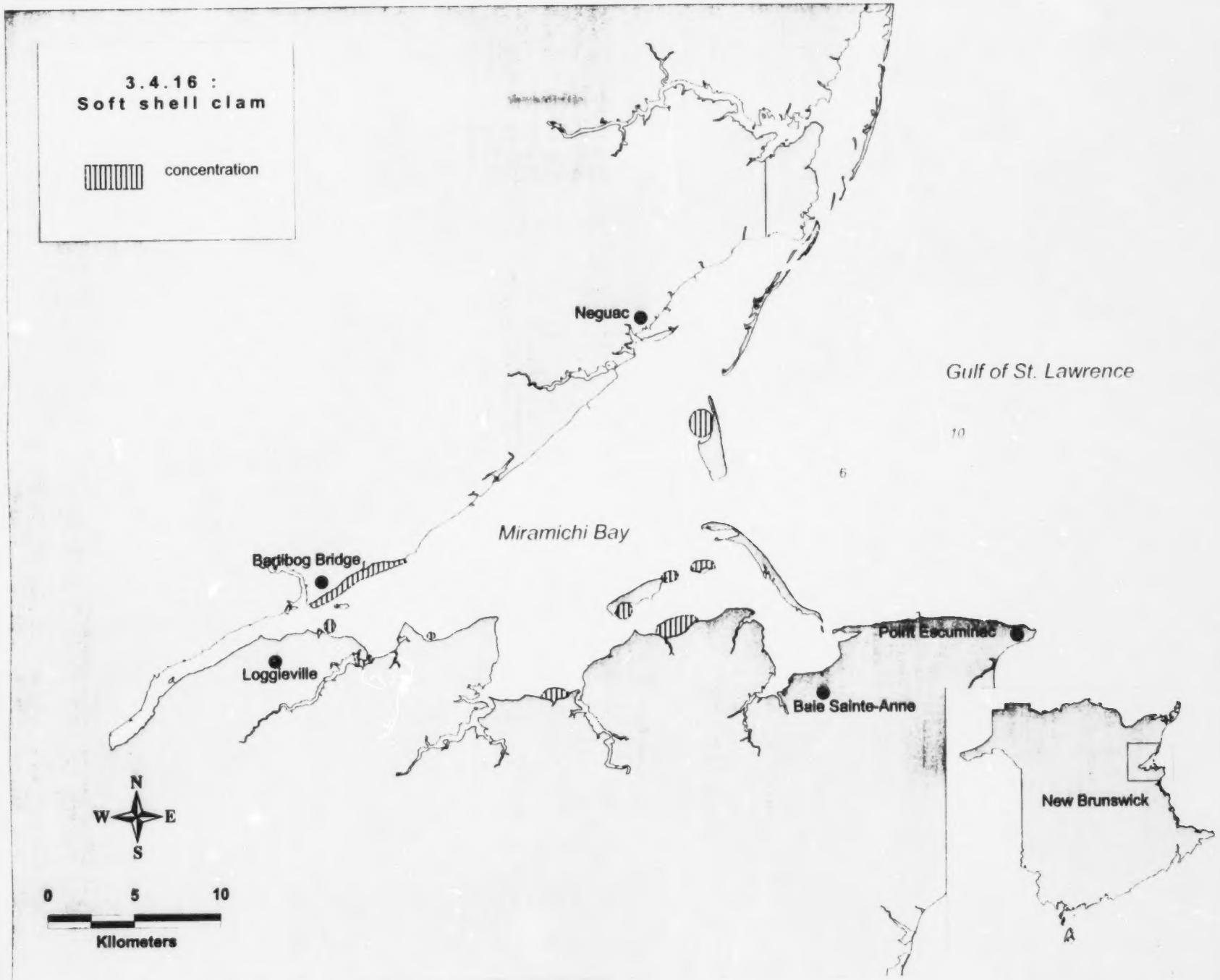

3.4.12 : Bar clam
concentration
Borden
P.E.I.
Murray Corner
Cape Tormentine
Port Elgin
Baie Verte
Tidnish
Northport
Port Howe
Northumberland Strait
New Brunswick
N
W
E
S
0
5
10
Kilometers

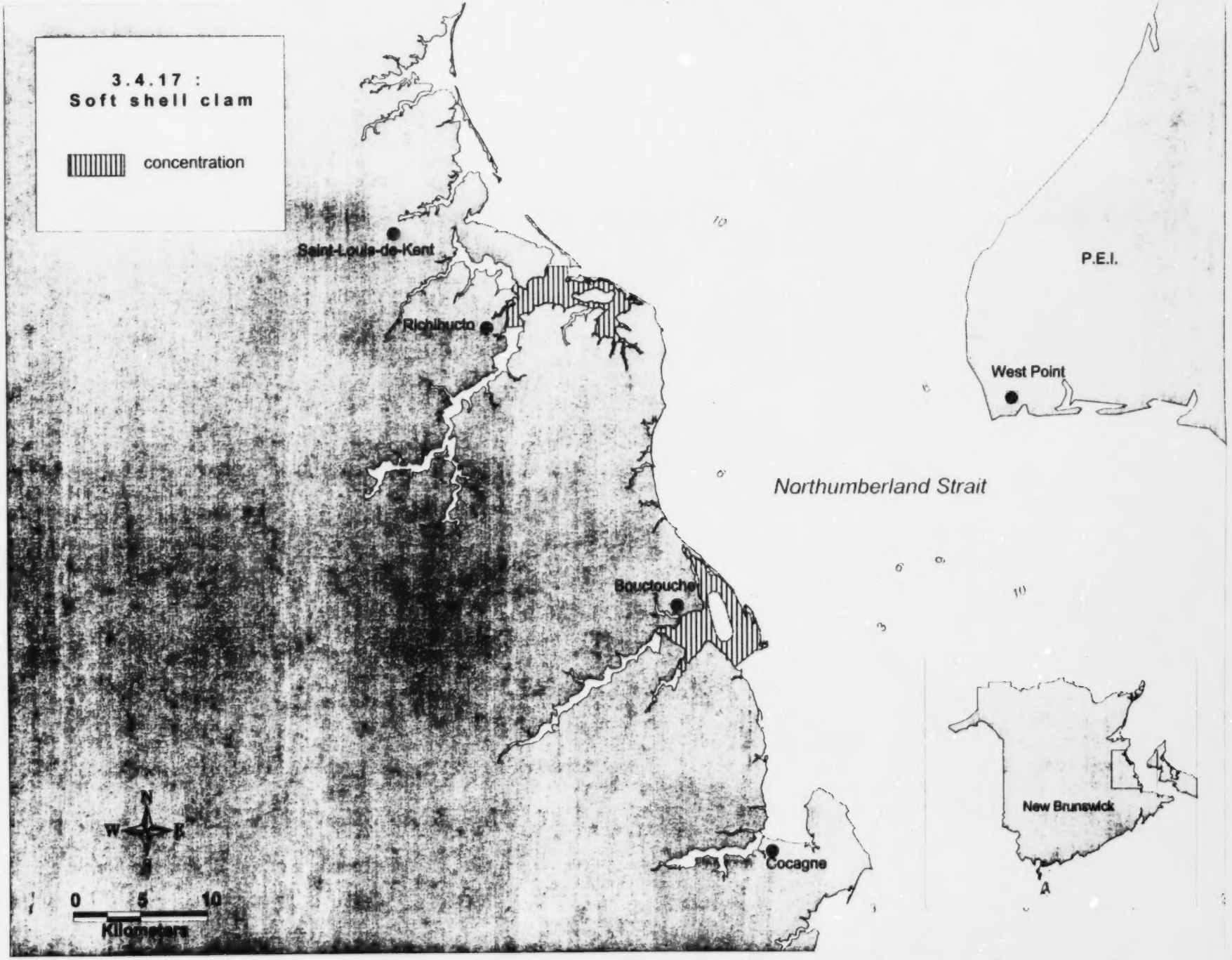
3.4.13 :
Blue Mussel
concentration
Miscou Island
Chaleur Bay
Lamèque Island
Caraquet
Shippagan
New Brunswick
Gulf of St. Lawrence
N
W
E
S
0
4
8
Kilometers

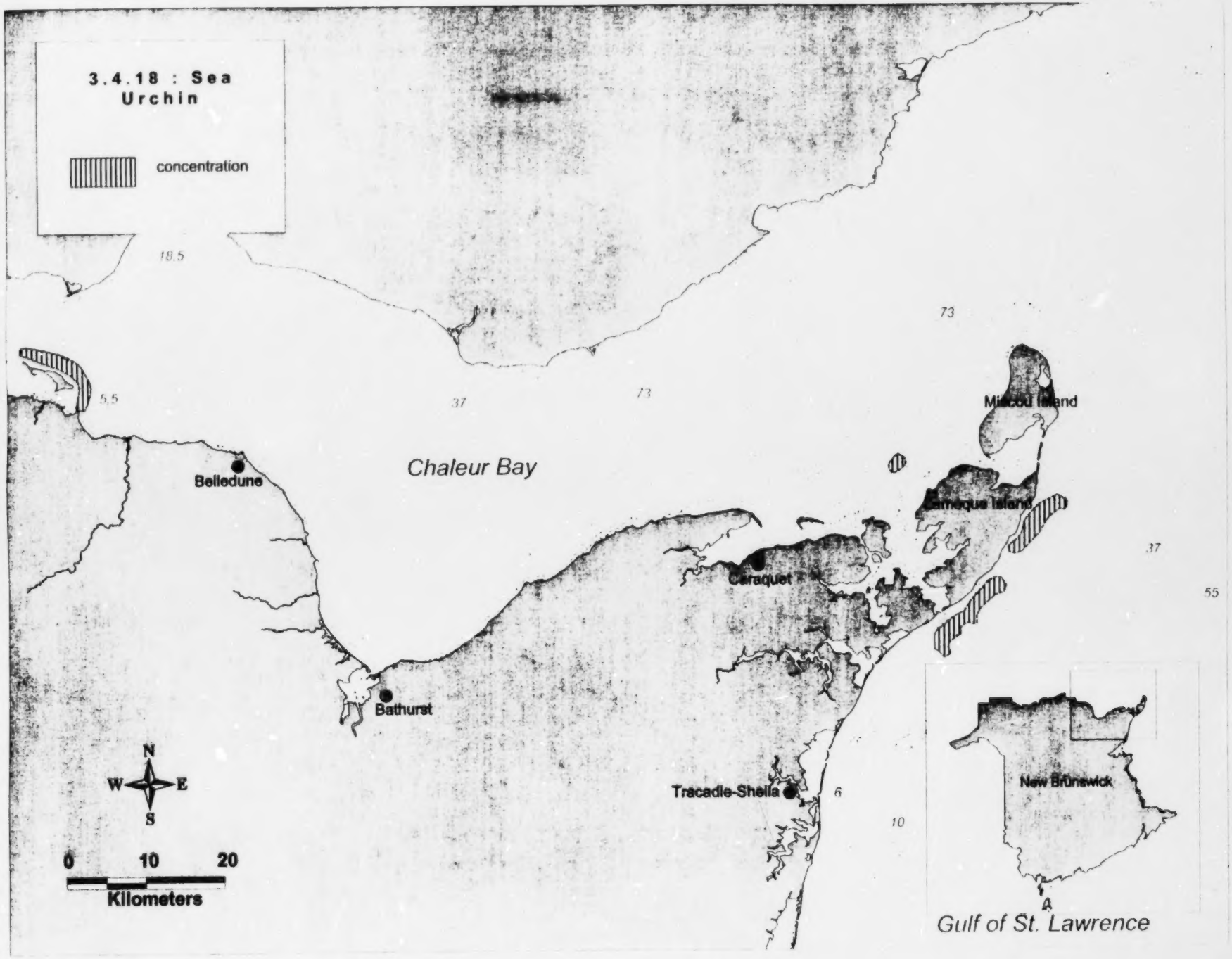
3.4.14 :
Blue Mussel
concentration
Neguac
Gulf of St. Lawrence
Miramichi Bay
Baribog Bridge
Loggieville
Point Escuminac
Baie Sainte-Anne
New Brunswick
N
W
E
S
0
5
10
Kilometers

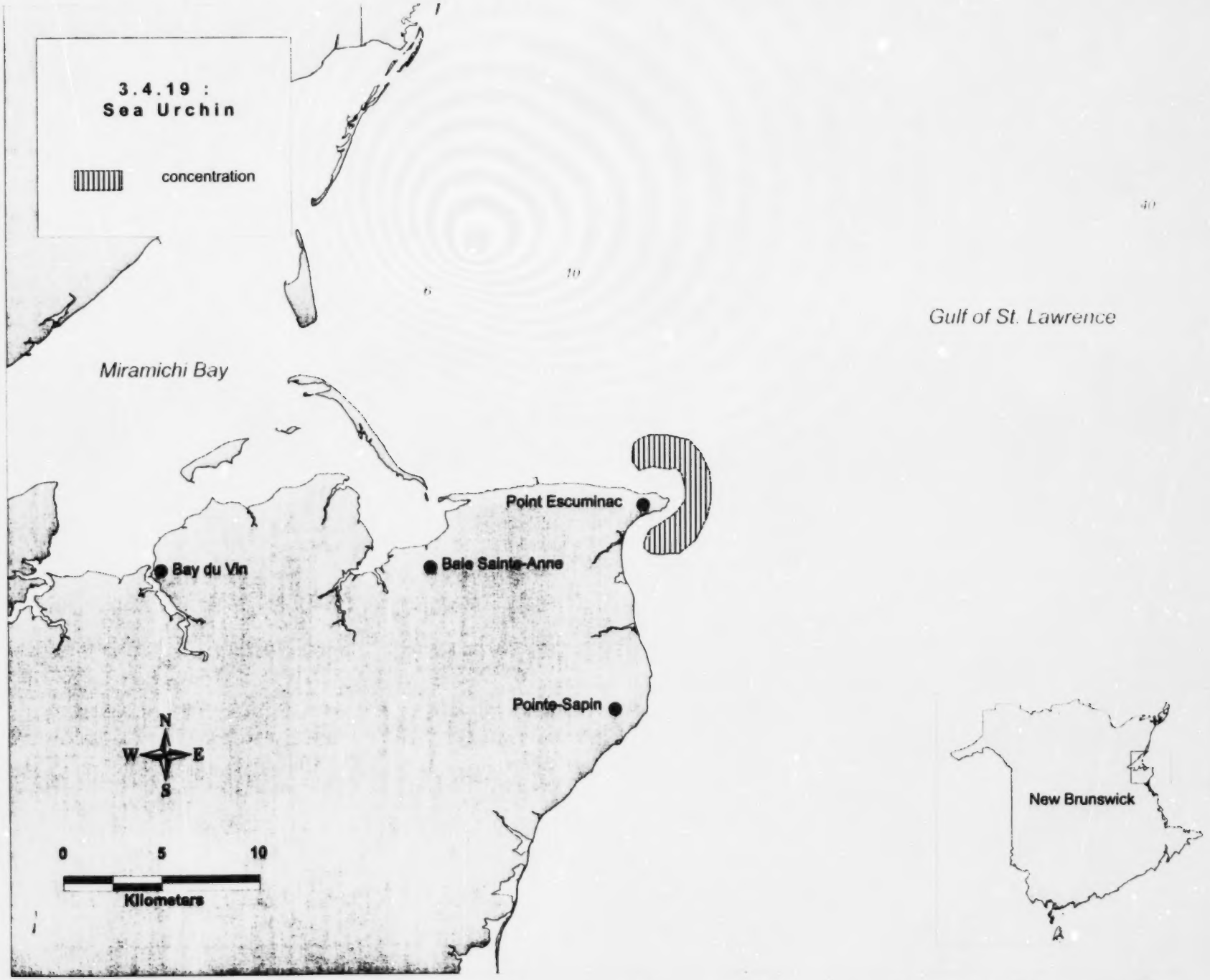
3.4.15 :
Soft shell clam

concentration


3.4.16 :
Soft shell clam
concentration
Neguac
Gulf of St. Lawrence
Miramichi Bay
Bartibog Bridge
Loggieville
Point Escuminac
Baie Sainte-Anne
New Brunswick
N
W
E
S
0
5
10
Kilometers

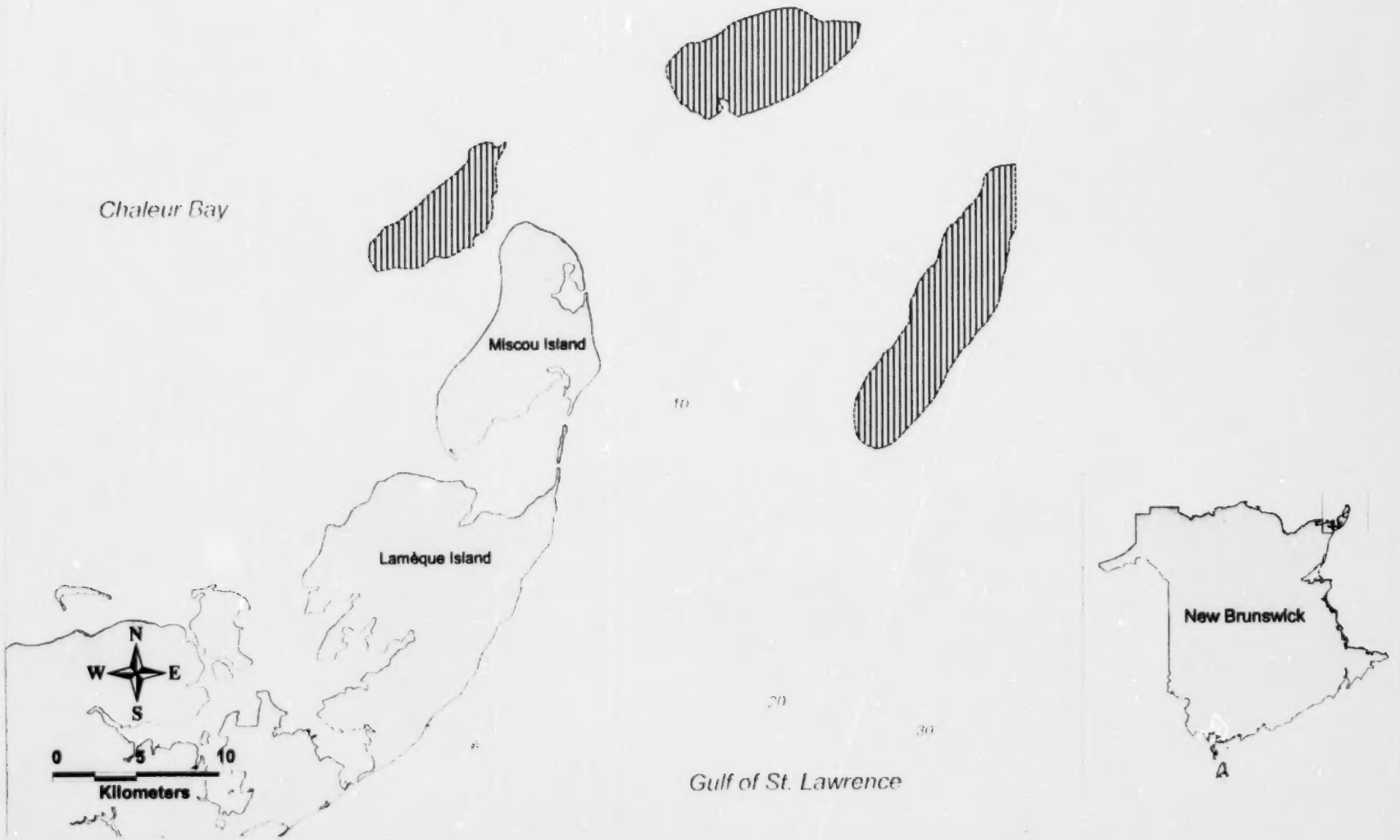

3.4.17 :
Soft shell clam
concentration
Saint-Louis-de-Kent
Richibucto
Bouctouche
Cocagne
P.E.I.
West Point
Northumberland Strait
New Brunswick
N
W
E
S
0
5
10
Kilometers

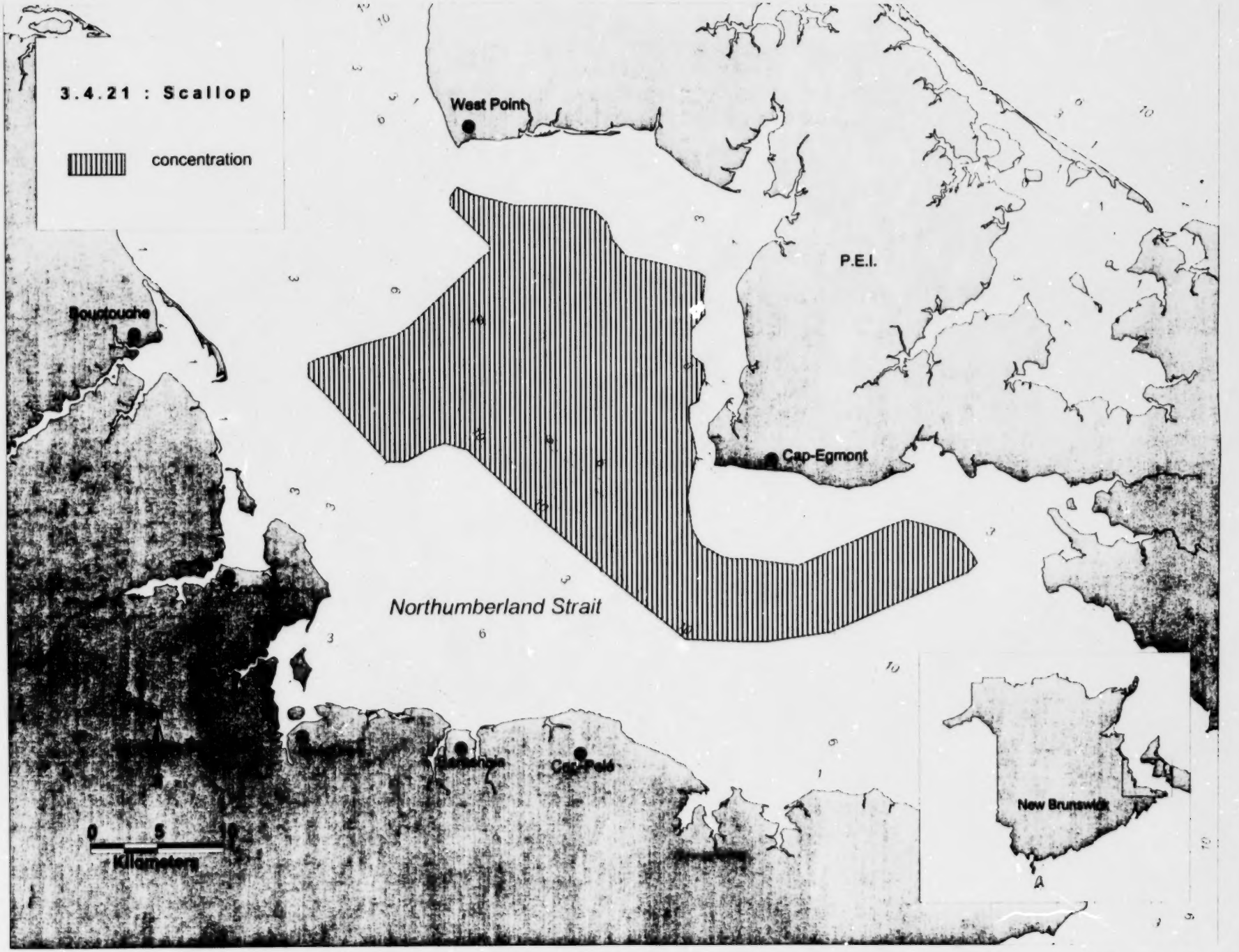

3.4.18 : Sea Urchin
concentration
18.5
73
5.5
37
73
Miscou Island
Chaleur Bay
Belledune
Lameque Island
37
Caraquet
55
Bathurst
N
W
E
S
0
10
20
Kilometers
Tracadie-Sheila
6
10
New Brunswick
A
Gulf of St. Lawrence

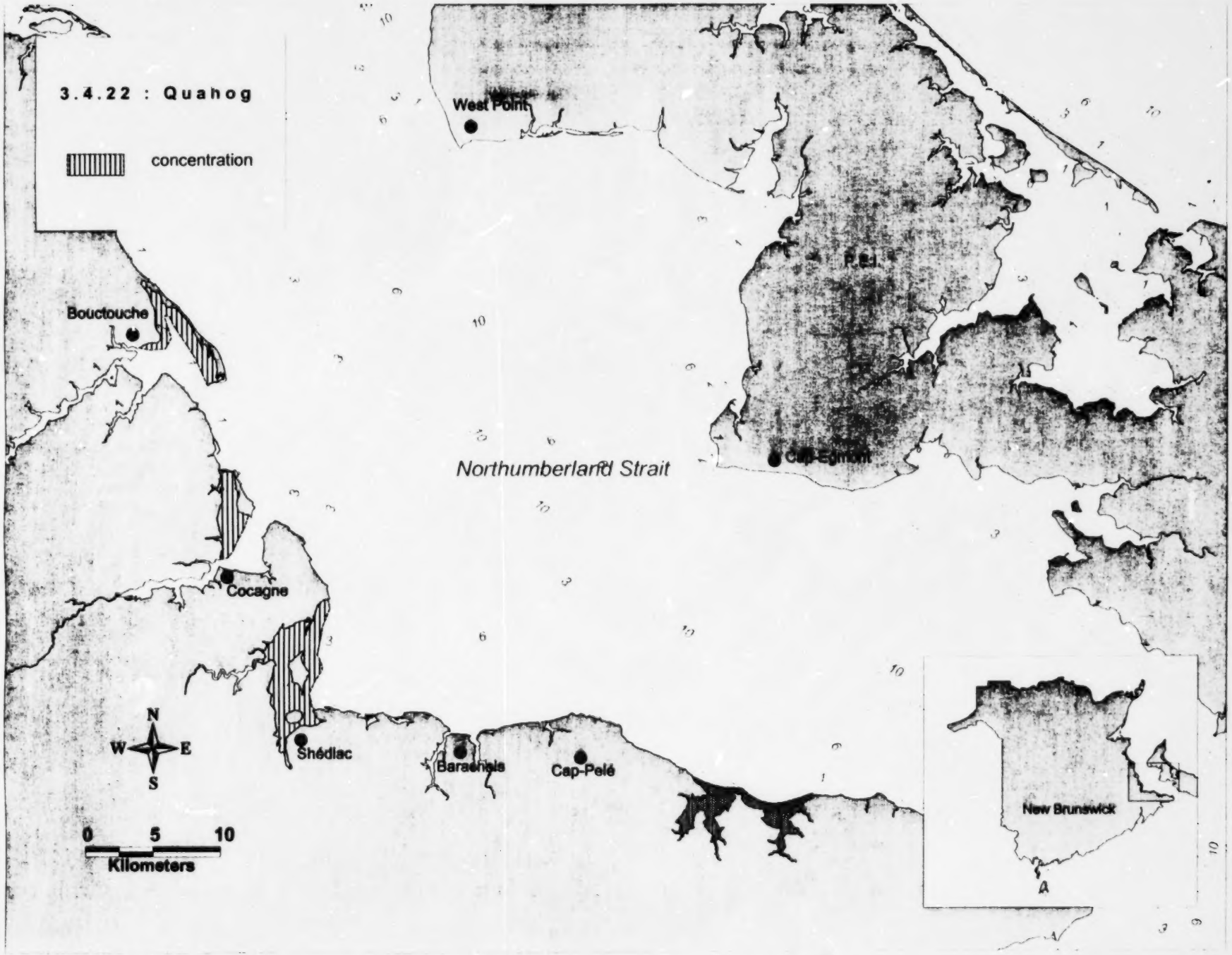

3.4.19 :
Sea Urchin
concentration
Miramichi Bay
Gulf of St. Lawrence
Point Escuminac
Bay du Vin
Baie Sainte-Anne
Pointe-Sapin
N
W
E
S
0
5
10
Kilometers
New Brunswick

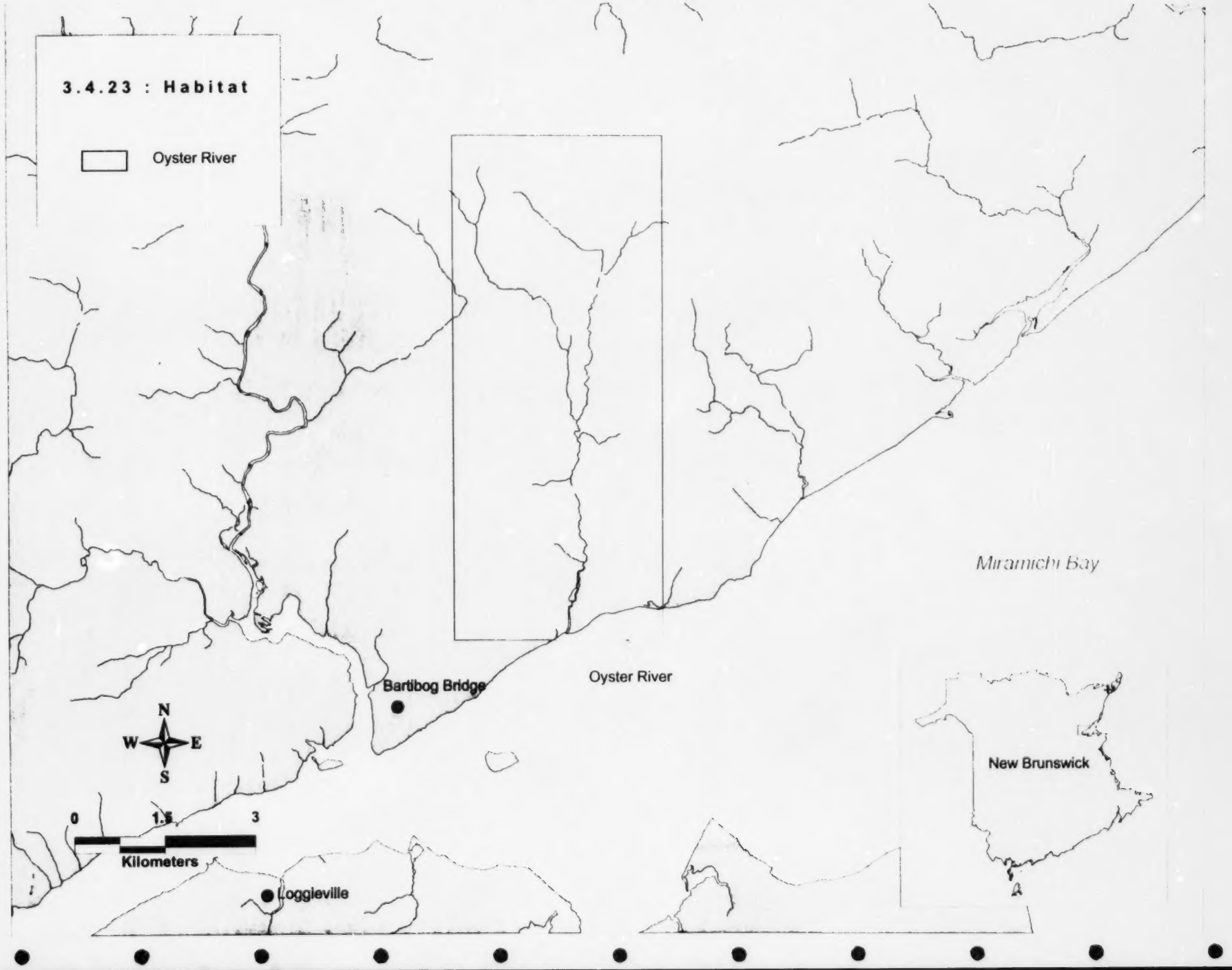
3.4.20 : Scallop

concentration



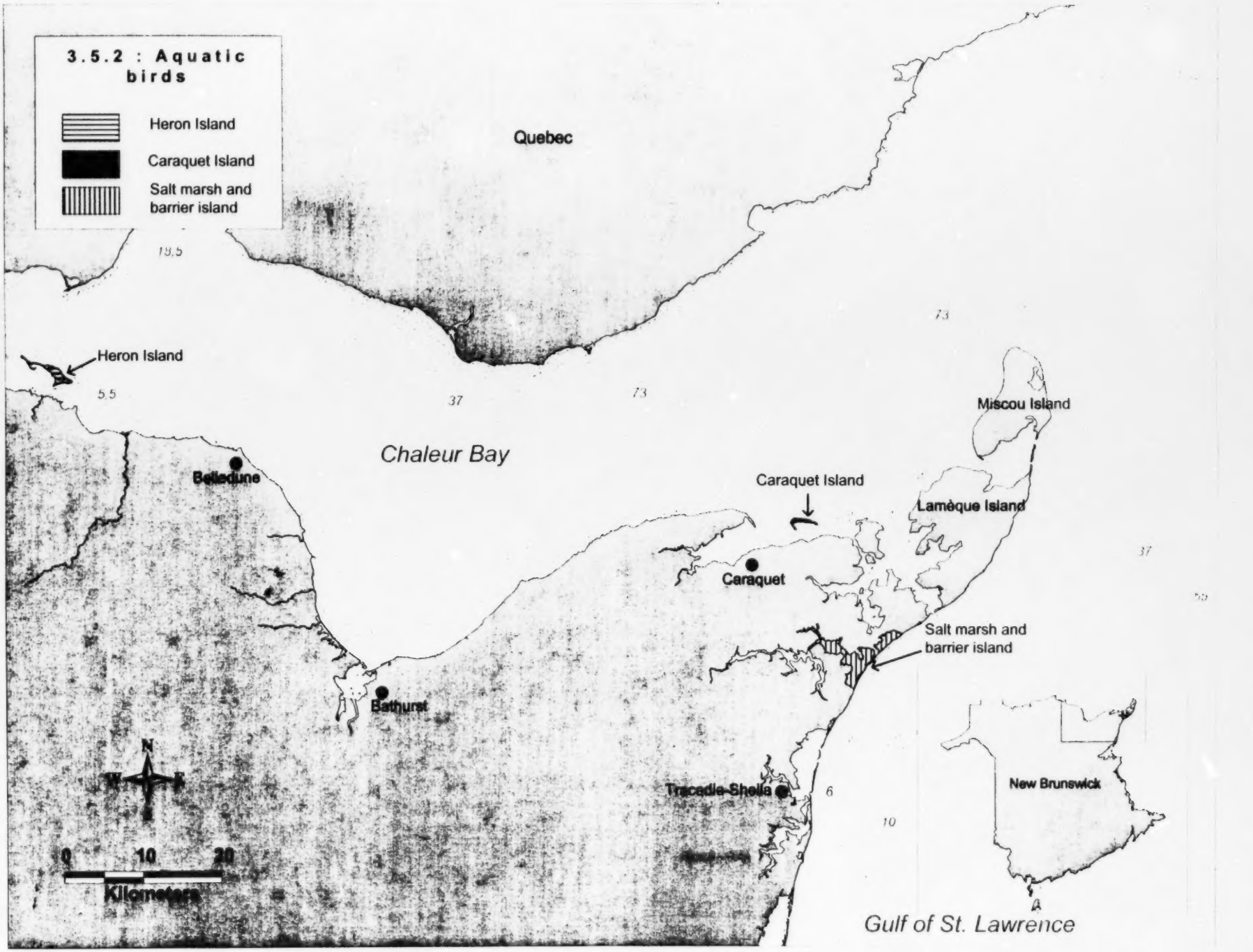

3.4.21 : Scallop
concentration
West Point
P.E.I.
Bouctouche
Cap-Egmont
Northumberland Strait
Cap-Pelé
New Brunswick
0 5 10
Kilometers


3.4.22 : Quahog
concentration
West Point
P.E.I.
Bouctouche
Cap-Egmont
Northumberland Strait
Cocagne
Shédiac
Barachois
Cap-Pelé
New Brunswick
N
W
E
S
0 5 10
Kilometers


3.4.23 : Habitat
Oyster River
Miramichi Bay
Oyster River
Bartibog Bridge
N
W
E
S
0
1.5
3
Kilometers
Loggieville
New Brunswick

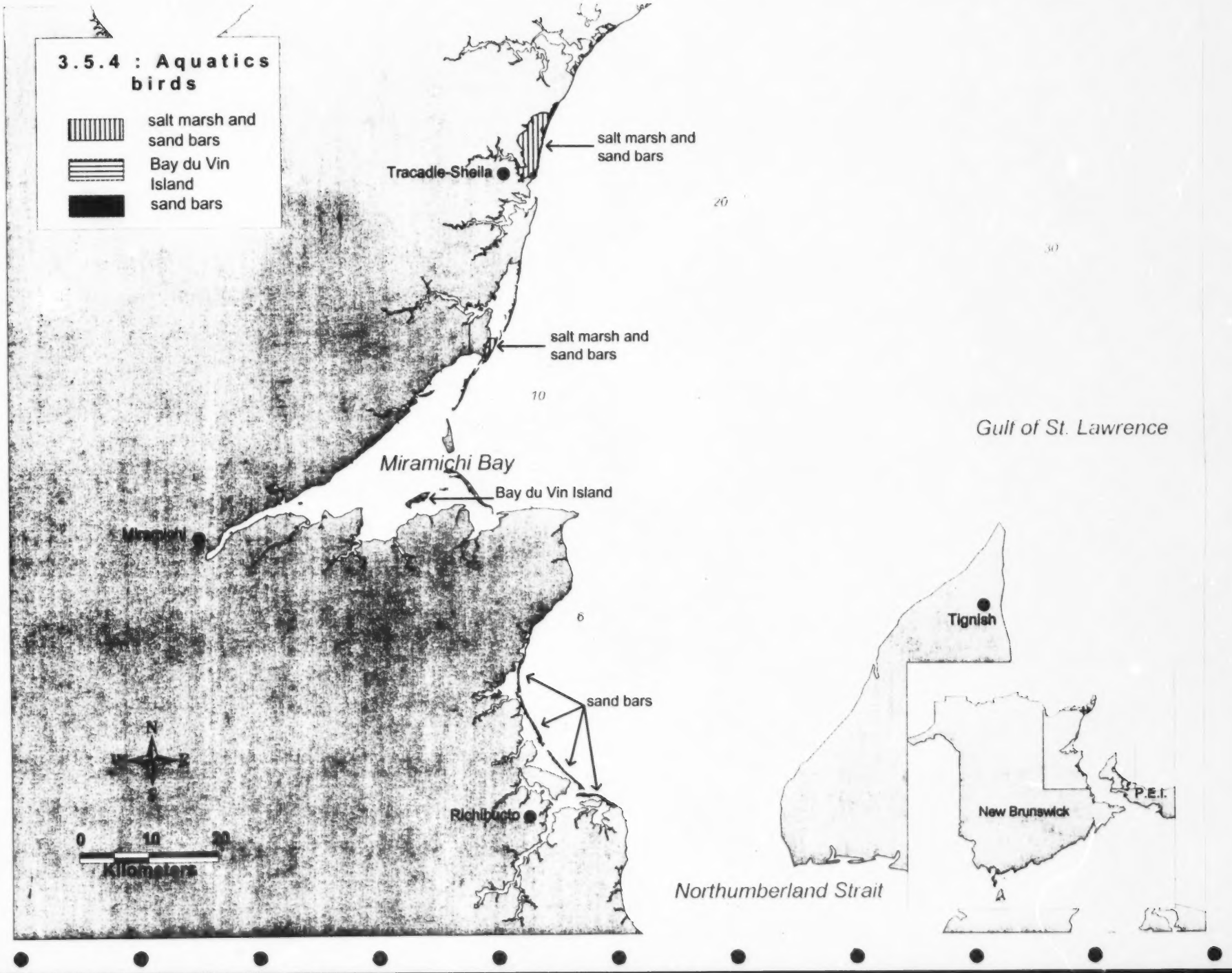
3.5.1 :
Harbour porpoise

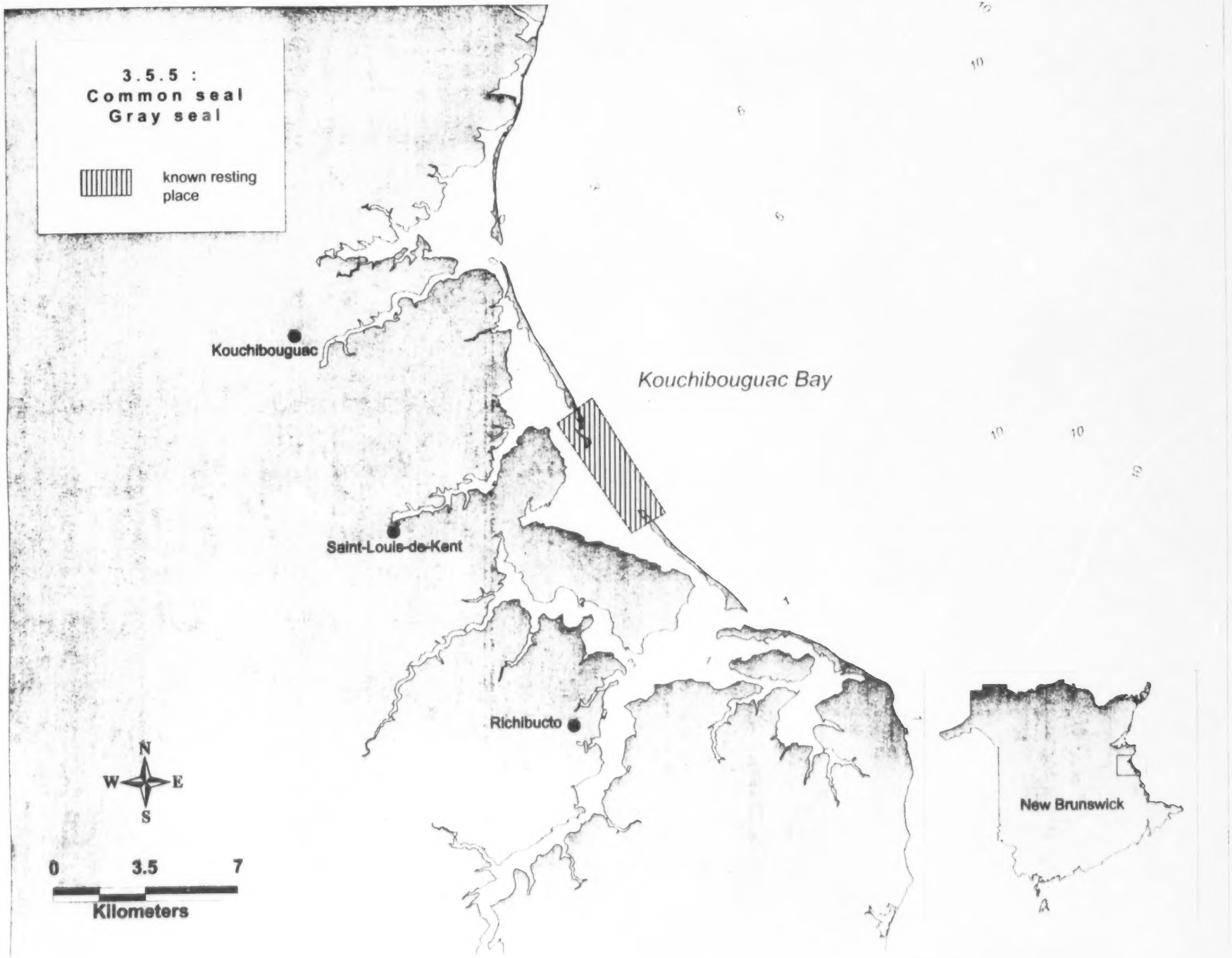
concentration

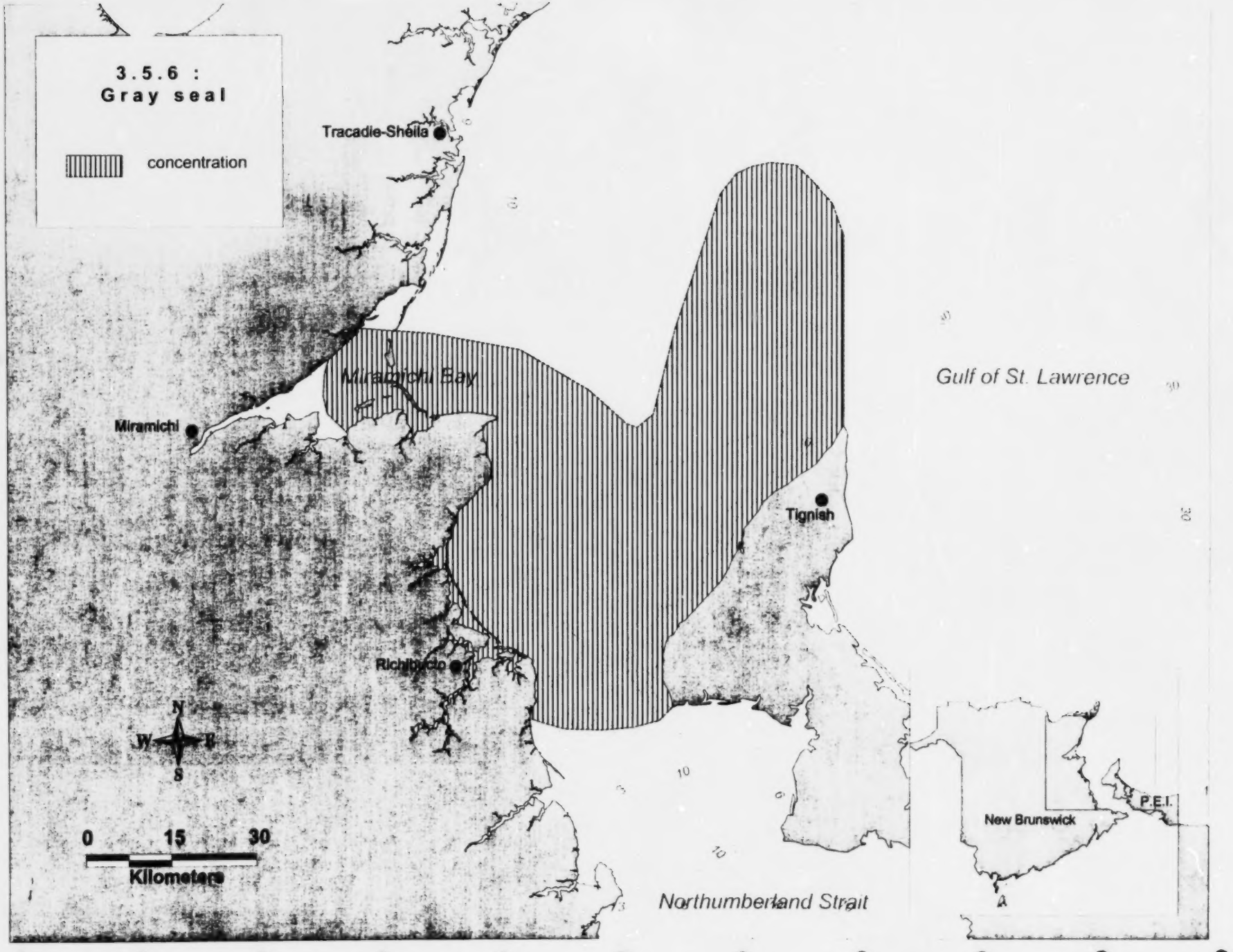

3.5.2 : Aquatic birds
Heron Island
Caraquet Island
Salt marsh and barrier island
Quebec
Heron Island
Chaleur Bay
Belledune
Caraquet Island
Miscou Island
Lamèque Island
Caraquet
Salt marsh and barrier island
Bathurst
Tracadie-Sheila
New Brunswick
Gulf of St. Lawrence
N
W
E
0
10
20
Kilometers

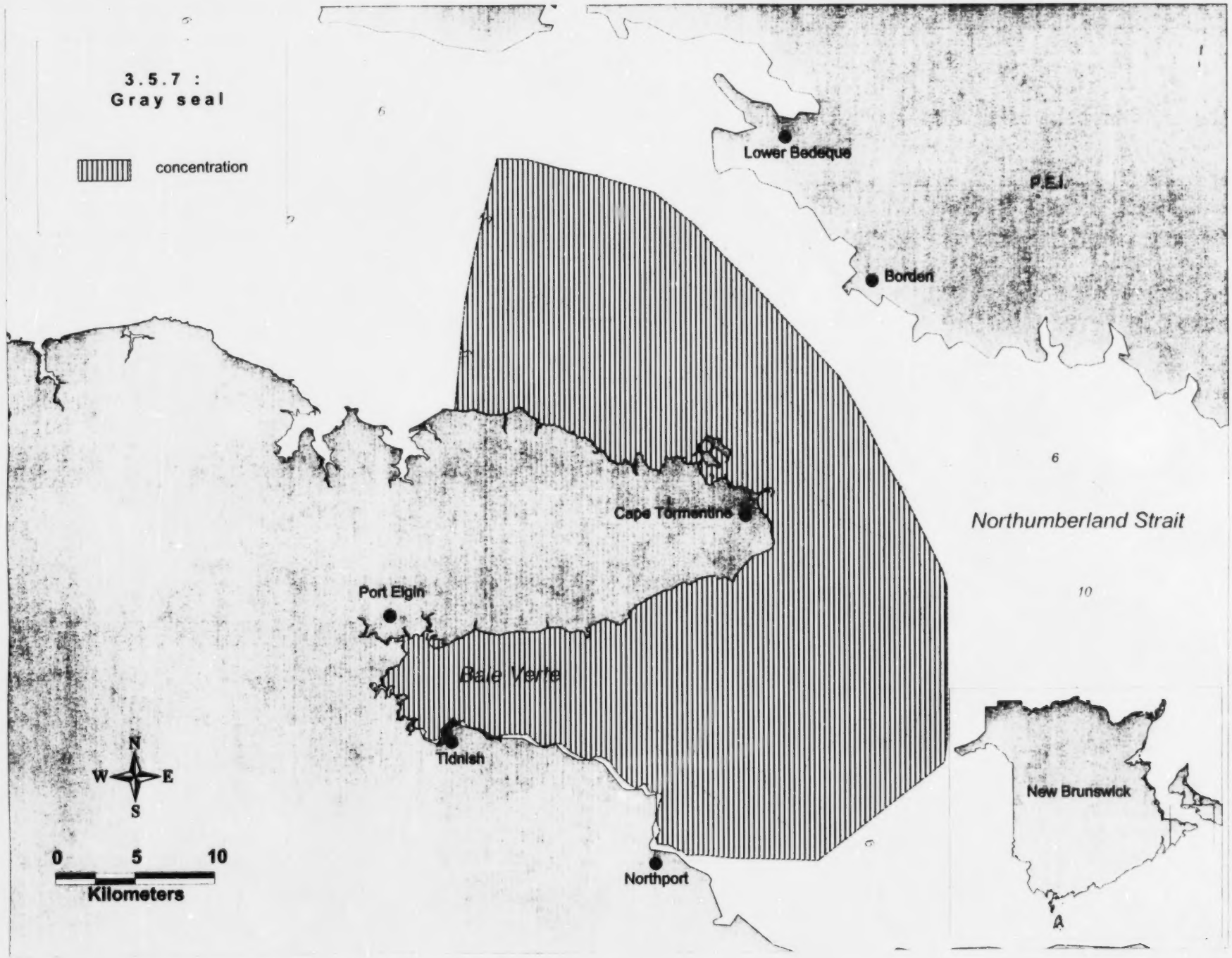
3.5.3 : Aquatic birds

Miscou Island
MalBay


3.5.4 : Aquatics birds
salt marsh and sand bars
Bay du Vin Island sand bars
salt marsh and sand bars
Tracadie-Sheila
salt marsh and sand bars
Miramichi Bay
Bay du Vin Island
Miramichi
sand bars
Richibucto
N
W
E
S
0
10
20
Kilometers
Gulf of St. Lawrence
Tignish
P.E.I.
New Brunswick
Northumberland Strait


3.5.5 :
Common seal
Gray seal
known resting place
Kouchibouguac
Kouchibouguac Bay
Saint-Louis-de-Kent
Richibucto
N
W
E
S
0
3.5
7
Kilometers
New Brunswick


3.5.6 :
Gray seal
concentration
Tracadie-Sheila
Miramichi Bay
Miramichi
Gulf of St. Lawrence
Tignish
Richibucto
N
W
E
S
0
15
30
Kilometers
P.E.I.
New Brunswick
Northumberland Strait


3.5.7 :
Gray seal
concentration
Lower Bedeque
P.E.I.
Borden
Cape Tormentine
Northumberland Strait
Port Elgin
Baie Verte
Tidnish
Northport
New Brunswick
N
W
E
S
0
5
10
Kilometers

APPENDIX B

Latin names for species mentioned in the text

Appendix B. Latin names for faunic species mentioned.

Common name	Latin name
American eel	*Anguilla rostrata*
American lobster	*Homarus americanus*
American oyster	*Crassostrea virginica*
American plaice	*Hippoglossoides platessoides*
American sand lance	*Ammodytes americanus*
American shad	*Alosa sapidissima*
Atlantic cod	*Gadus morhua*
Atlantic halibut	*Hippoglossus hippoglossus*
Atlantic herring	*Clupea harengus*
Atlantic mackerel	*Scomber scombrus*
Atlantic salmon	*Salmo salar*
Atlantic tomcod	*Microgadus tomcod*
Banded killifish	*Fundulus diaphanus*
Black duck	*Anas rubripes*
Black-legged Kittiwake	*Rissa tridactyla*
Blue mussel	*Mytilus edulis*
Blueback herring	*Alosa aestivalis*
Bluefin tuna	*Thunnus thynnus*
Brant	*Branta bernicla*
Capelin	*Mallotus villosus*
Common eider	*Somateria mollissima*
Common seal	*Phoca vitulina*
Common tern	*Sterna hirundo*
Dovekie	*Alle alle*
Gaspereau / Alewife	*Alosa pseudoharengus*
Gray seal	*Halichoerus grypus*
Great blue heron	*Ardea herodias*
Green sea urchin	*Strongylocentrotus dröebachiensis*
Gulls	*Larus sp*
Harbour porpoise	*Phocoena phocoena*
Harlequin duck	*Histrionicus histrionicus*
Heron	*Nycticorax sp*
Loons	*Gavia sp.*
Mummichog	*Fundulus heteroclitus*
Murre	*Uria sp*
Northern Gannet	*Morus bassanus*
Northern shrimp	*Pandalus borealis*
Oldsquaw	*Clangula hyemalis*

Piping plover	*Charadrius melodus*
Quahog	*Mercenaria mercenaria*
Rainbow smelt	*Osmerus mordax*
Rock crab	*Cancer irroratus*
Scoters	*Melanitta sp*
Sculpin	*Myoxocephalus sp.*
Sea lamprey	*Petromyzon marinus*
Sea scallop	*Placopecten magellanicus*
Silverside	*Menidia menidia*
Smooth flounder	*Pleuronectes putnami*
Snowcrab	*Chionoecetes opilio*
Soft shell clam	*Mya arenaria*
Squid	*Illex illecebrosus / Loligo pealei*
Stickleback	*Gasterosteus sp. /Pungitius sp. / Apeltes sp. /Culuca sp.*
Stimpson's surf clam	*Mactromeris polynyma*
Striped bass	*Morone saxatilis*
Surf clam	*Spisula solidissima*
Whale	*Balaenoptera sp.*
White hake	*Urophysis tenuis*
Winter flounder	*Pleuronectes americanus*

APPENDIX C

Names of resource persons contacted or interviewed

Appendix C. Names of resource persons contacted or interviewed

Researchers contacted or interviewed

Diane Archambault--Fisheries and Oceans Canada, Mont-Joli, Qc
Rod Bradford--Fisheries and Oceans Canada, Moncton, N.B.
Gérald Chaput--Fisheries and Oceans Canada, Moncton, N.B.
Simon Courtenay--Fisheries and Oceans Canada, Moncton, N.B.
Ghislain Chouinard--Fisheries and Oceans Canada, Moncton, N.B.
Harry Collins – *Miramichi River Environmental Assessment Committee*, Miramichi, N.B.
Leslie-Ann Davidson--Fisheries and Oceans Canada, Moncton, N.B.
Jean-François Gosselin--Fisheries and Oceans Canada, Mont-Joli, Qc
François Grégoire--Fisheries and Oceans Canada, Mont-Joli, Qc
Denis Haché--Fisheries and Oceans Canada, Moncton, N.B.
Mark Hanson--Fisheries and Oceans Canada, Moncton, N.B.
Tom Hurlbut--Fisheries and Oceans Canada, Moncton, N.B.
Thomas Landry--Fisheries and Oceans Canada, Moncton, N.B.
Wade Landsburg--Fisheries and Oceans Canada, Moncton, N.B.
Léon Lanteigne--Senpaq consultants, Tracadie-Sheila, N.B.
Marc Lanteigne--Fisheries and Oceans Canada, Moncton, N.B.
Steven Lanteigne--N.B. Department of Fisheries and Aquaculture, Buctouche, N.B.
Claude LeBlanc--Fisheries and Oceans Canada, Moncton, N.B.
Érik Tremblay--Kouchibouguac National Park, Kouchibouguac, N.B.
Diane Amirault--Canadian Wildlife Service, Sackville, N.B.
Kevin Davidson--Canadian Wildlife Service, Sackville, N.B.
Colin MacKinnon--Canadian Wildlife Service, Sackville, N.B.

Fisheries agents contacted or interviewed

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J.M.A. Doucet
E. Doucette
A. Duguay
D.A Durelle
J.P. Durelle
G.J. Ferguson
V.T. Ferguson
A.T. Gosselin
B. Hubbard
G. Landry
A.D. Lanteigne
J.A.C. Larocques
C.A. Légère
J. Léonard
D.L. Lévesque
M.J. Lévesque
K.J. Levi
B. Lewis
D. Macdonnell
M. MacFarlane
R.M. MacNair
B. Mallet
J.Y. Mallet
R.W. Manderson
D. Martin
G.G. Nadeau
M. Randall
S.J. Richard
B.P. Ross
R.G. Roy
S.J. Savoy
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S.J. Stewart
K. Sturgeon
W.J.Thompson
P. Ward
B.K. Whitty